Chapter 14
Land, Soils, Geology & Hydrogeology

Contents

14. Land, Soils, Geology & Hydrogeology

14.1 Introduction

This Chapter of the Environmental Impact Assessment Report (EIAR) considers the potential impacts on land, soils, geology and hydrogeology as a result of the Construction and Operational Phases of the Liffey Valley to City Centre Core Bus Corridor Scheme (hereafter referred to as the Proposed Scheme). Chapter 4 (Proposed Scheme Description) includes a full description of the Proposed Scheme.

During the Construction Phase, the potential land, soils, geology and hydrogeology impacts associated with the development of the Proposed Scheme have been assessed. This includes the potential for contamination of soils and groundwater, and the loss of natural soils from excavation activities associated with utility diversions, road resurfacing, and road realignments.

During the Operational Phase, the potential land, soils, geology and hydrogeology impacts associated with changes to water supply and the pollution of groundwater and watercourses have been assessed.

Potential impacts in the surface water environment are not considered in this assessment but are considered separately in Chapter 13 (Water).

The assessment has been carried out according to best practice and guidelines relating to land, soils, geology and hydrogeology assessment, and in the context of similar large-scale infrastructure projects.

An assessment is made of the likely significant impacts associated with the Construction and Operational Phases of the Proposed Scheme on these resources. Measures are presented to avoid or reduce potential impacts of the Proposed Scheme on the soils, subsoils, bedrock, geological resources and heritage and hydrogeology.

The aim of the Proposed Scheme when in operation is to provide enhanced walking, cycling and bus infrastructure on this key access corridor in the Dublin region, which will enable and deliver efficient, safe, and integrated sustainable transport movement along the corridor. The objectives of the Proposed Scheme are described in Chapter 1 (Introduction). The Proposed Scheme which is described in Chapter 4 (Proposed Scheme Description) has been designed to meet these objectives.

The design of the Proposed Scheme has evolved through comprehensive design iteration, with particular emphasis on minimising the potential for environmental impacts, where practicable, whilst ensuring the objectives of the Proposed Scheme are attained. In addition, feedback received from the comprehensive consultation programme undertaken throughout the option selection and design development process have been incorporated, where appropriate.

14.2 Methodology

The following Sections outline the legislation and guidelines considered, and the adopted methodology for defining the baseline environment and undertaking the assessment in terms of land, soils, geology and hydrogeology.

The significance of potential impacts of the Proposed Scheme on land, soils, geology and hydrogeology have been assessed by classifying the importance of the relevant attributes and quantifying the likely magnitude of any impact on these attributes.

14.2.1 Study Area

The land, soils, geology and hydrogeology study area for the Proposed Scheme extends 250m (metres) either side of the Proposed Scheme boundary which is in accordance with the Institute of Geologists of Ireland (IGI) Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements (hereafter referred to as the IGI Guidelines) (IGI 2013).

The Proposed Scheme has been divided into sub-sections for ease of presentation and due to the volume of information available. The sub-sections of the Proposed Scheme are as follows:

- Liffey Valley to Le Fanu Road;
- Le Fanu Road to Sarsfield Road; and
- Sarsfield Road to City Centre.

14.2.2 Relevant Guidelines, Policy and Legislation

The main documents that have been followed for the preparation of the land, soils, geology and hydrogeology assessment are:

- IGI Guidelines (IGI 2013); and
- National Roads Authority (NRA) Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (hereafter referred to as the NRA Guidelines) (NRA 2008a).

Though the NRA is now known as Transport Infrastructure Ireland (TII), for the purpose of this Chapter the guidelines mentioned above are referred to as the NRA Guidelines.

In addition, the assessment has been prepared using the following guidelines:

- Environmental Protection Agency (EPA) Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (hereafter referred to as the EPA Guidelines) (EPA 2022a);
- European Commission (EC) Environmental Impact Assessment of Projects Guidance on the preparation of the Environmental Impact Assessment Report (EC 2017);
- Environmental Impact Assessment of National Road Schemes – A Practical Guide (NRA 2008b);
- Strive Report Series No. 100. Evaluating the Influence of Groundwater Pressures on Groundwater-Dependent Wetlands. Strive EPA Programme 2007 - 2013 (EPA 2011); and
- Environmental Research Centre Report Series No. 12. A Framework for the Assessment of Groundwater-Dependent Terrestrial Ecosystems under the Water Framework Directive (WFD). Strive EPA Programme 2007 – 2013 (EPA 2008).

14.2.3 Data Collection and Collation

Data was compiled from publicly available datasets, the findings of ground investigations, design information, a scheme walkover survey, and other sources, as outlined below.

14.2.3.1 Publicly Available Datasets

The publicly available datasets listed in Table 14.1 have been acquired and consulted in the assessment of the baseline conditions. All datasets were accessed throughout 2020 and 2021.

Table 14.1: Publicly Available Datasets

Source	Name	Description
Ordnance Survey Ireland (OSI)	Current and historical ordnance survey maps	Current and historical survey maps produced by the OSI.
OSI	Aerial photography	Current and historical survey maps produced by the OSI.
Google	Aerial photography	Current aerial imagery produced by Google
Bing	Aerial photography	Current aerial imagery produced by Bing (Bing 2022)
Teagasc	Teagasc Soils Data	Surface soils classification and description
Geological Survey Ireland (GSI)	Quaternary Mapping	Geological maps of the site area produced by the GSI and available on GSI online map viewer.
	Bedrock Mapping	
	Aggregate Potential Mapping	
	Mineral Localities	
	Geotechnical viewer	
	Groundwater Mapping	
	Groundwater Levels	
	National Landslide Database	
	Karst Database	
	Active Quarries and pits	
	County Geological Sites (CGS) and Geological Heritage Areas	
	GSI, Memoirs	
EPA	Corine Land Cover	These datasets are based on interpretation of satellite imagery and national in-situ vector data.
	Designated Natural Heritage Area (NHA). Special Protection Area (SPA), Special Area of Conservation (SAC) sites.	
	River Network Map	
	EPA Hydro Net	Reports of groundwater level monitoring points.
National Parks and Wildlife Service (NPWS)	Mapping within the area of the Proposed Scheme	This dataset provides information on national parks, protected sites and nature reserves
National Monuments Service (NMS)	State Mining and Prospecting Facilities	This dataset provides all recorded archaeological monuments (NMS 2022)
Department of Communications, Energy and Natural Resources (DCENR)	Minerals Ireland	A booklet contains a list of all current and prospecting mining facilities.
	Historic Mine Sites – Inventory and Risk Classification	An inventory of historic mines in Ireland that includes detailed geochemical analysis

14.2.3.2 Ground Investigation

The details of the historical ground investigation reports located within the study area which have been used in the assessment of the baseline conditions are presented in Table 14.2. These reports are publicly available from the Geological Survey of Ireland (GSI) Spatial Resources Map Viewer 'EXT GSI Geotechnical Sites layer' (GSI 2019a).

Table 14.2: Existing Ground Investigations

GSI Report ID	Title	Year	Author	Location	Scope
R6929	Eircom Depot	2006	IGSL	Kennelsfort Road, Palmerstown	Two Trial Pits
R5588	Lidl Supermarket	2003	IGSL	Ballyfermot Road	One Borehole (non-specified)
R7467	Ballyfermot Civic Space	2007	IGSL	Ballyfermot Road	12 Trial Pits Six dynamic probes
R6241	Claddagh Green	2005	IGSL	Claddagh Green	Five cable percussion boreholes Eight trial pits Eight dynamic probes
R5458	Ballyfermot Swimming Pool	2003	IGSL	Le Fanu Road	Five cable percussion boreholes Five trial pits
R5124	Ballyfermot Senior Citizens Club	2002	IGSL	Ballyfermot Road	Two trial pits
R147	Residential Development	1995	IGSL	The Steeples, Saint Laurence Road	Three cable percussion boreholes
R976	St. Marys Terrace	1986	IGSL	Sarsfield Road, Dublin 8	Five cable percussion boreholes (shell and auger)
R4284	Heuston Station	Unknown	Unknown	Heuston Station	Three cable percussion boreholes (shell and auger)
R716	Dublin Rapid Transit Project	1982	Site Investigations Ltd.	Tallaght-Heuston	Seven cable percussion boreholes (shell and auger), 10 rotary coring boreholes, 33 trial pits
R6276	Inchicore Residential	2005	IGSL	Inchicore, Dublin 8	Four window samples and 14 dynamic probes
R5964	Redevelopment of St. Michaels Estate	2005	IGSL	Inchicore, Dublin 8	Six boreholes and six trial pits
R6721	Inchicore apartments	2006	IGSL	Inchicore, Dublin 8	Five boreholes and 3 trial pits
R4492	Grattan Crescent Development	Unknown	Unknown	Inchicore, Dublin 8	Four cable percussion boreholes (shell and auger) and One trial pit
R7257	Development at Old Kilmainham	Unknown	Unknown	Brookfield Road, Kilmainham	One cable percussion (shell and auger) and one window sample

No scheme-specific ground investigations were carried out to inform the Proposed Scheme and EIAR.

14.2.3.3 Design Information

The design information as provided in Chapter 4 (Proposed Scheme Description) and Chapter 5 (Construction), as well as the Plan and Profile Drawings (BCIDB-JAC-GEO_HV-0007_ML_00-DR-CR-9001 in Volume 3 of this EIAR), have been used in the assessment.

14.2.3.4 Scheme Walkover

A scheme walkover survey was carried out on 21 January 2020 and 9 July 2021 to inform and verify the review of publicly available datasets.

The findings of the scheme walkover survey including photos and scheme walkover survey notes are included in Appendix A14.1 Scheme Walkover Summary in Volume 4 of this EIAR.

14.2.4 Appraisal Method for the Assessment of Impacts

The impact assessment for this Chapter has been carried out in accordance with the NRA Guidelines (NRA 2008a) and the IGI Guidelines (IGI 2013).

The likely significant impacts have been assessed by classifying the importance of the relevant attributes and quantifying the magnitude of any likely significant impacts on these attributes, as outlined below.

14.2.4.1 Baseline – Initial Assessment

In order to identify and quantify the likely significant impacts of the Construction Phase and Operational Phase of the Proposed Scheme, it is first necessary to undertake a detailed study of the (baseline) geological and hydrogeological environment of the study area for the Proposed Scheme.

The existing land, soils, geology and hydrogeology conditions in the study area have been interpreted from review of existing data, consultation and scheme walkover surveys.

This assessment includes the development of a preliminary Conceptual Site Model (CSM), which describes the ground conditions expected throughout the study area of the Proposed Scheme based on existing literature. Also, as part of this initial assessment, the preliminary generic type of geological / hydrogeological environment is determined. The IGI Guidelines (IGI 2013) provide five types of environments as examples (Types A to E), as described in Step 3 of the IGI Guidelines.

14.2.4.2 Baseline – Direct and Indirect Site Investigation

Information gathered on the baseline environment during specific ground investigations for the Proposed Scheme corresponds to the second element of the methodology, 'Direct and Indirect Site Investigation and Studies' (IGI 2013). However, no 'Direct Site Investigations' were required to be carried out for the Proposed Scheme.

As part of the second element, relevant 'Indirect Site Investigations and Studies' close to the Proposed Scheme are gathered and assessed. Then, the preliminary CSM is refined accordingly.

14.2.4.3 Gradation of Impacts

The NRA Guidelines (NRA 2008a) provide criteria and examples for determining likely significant impacts. The relevant tables from the NRA Guidelines (NRA 2008a) are as follows:

- Box 4.1: Criteria for Rating Site Attributes – Estimation of Importance of Soil and Geology Attributes (Table 14.3);
- Box 4.3: Criteria for Rating Site Attributes – Estimation of the Importance of Hydrogeology Attributes (Table 14.4);
- The magnitude of impacts should be defined in accordance with the criteria provided in the NRA Guidelines. This is outlined in Table 14.5;
- Box 5.1: Criteria for Rating Site Attributes at Environmental Impact Assessment (EIA) Stage – Estimation of Magnitude of Impact on Soil / Geology Attribute (Table 14.6);
- Box 5.3: Criteria for Rating Site Attributes at EIA Stage – Estimation of Magnitude of Impact on Hydrogeology Attributes (Table 14.7); and
- Box 5.4: Rating of Significant Environmental Impacts at EIA Stage (Table 14.8).

The NRA Guidelines criteria uses similar significance terminology as the EPA Guidelines (EPA 2022a). However, it has intermediate steps to justify using that terminology:

- Step 1: Quantify the importance of a feature for geology (Box 4.1) and hydrogeology (Box 4.3);
- Step 2: Estimate the magnitude of the impact on the feature from the Proposed Scheme (Box 5.1, Box 5.3); and
- Step 3: Determine the significance of the impact on the feature from the matrix (Box 5.4) based on the importance of the feature and the magnitude of the impact.

Table 14.3: Criteria for Rating the Importance of Identified Soils and Geological Attributes (Table C2 (IGI 2013) and Box 4.1 (NRA 2008a))

Importance	Criteria	Typical Example
Very High	Attribute has a high quality, significance or value on a regional or national scale. Degree or extent of soil contamination is significant on a national or regional scale. Volume of peat and / or soft organic soil underlying route is significant on a national or regional scale.	Geological feature rare on a regional or national scale (NHA) Large existing quarry or pit Proven economically extractable mineral resource
High	Attribute has a high quality, significance or value on a local scale. Degree or extent of soil contamination is significant on a local scale. Volume of peat and / or soft organic soil underlying route is significant on a local scale.	Contaminated soil on site with previous heavy industrial usage Large recent landfill site for mixed wastes Geological feature of high value on a local scale (County Geological Site) Well drained and / or highly fertility soils Moderately sized existing quarry or pit Marginally economic extractable mineral resource
Medium	Attribute has a medium quality, significance or value on a local scale. Degree or extent of soil contamination is moderate on a local scale. Volume of peat and / or soft organic soil underlying route is moderate on a local scale.	Contaminated soil on site with previous light industrial usage Small recent landfill site for mixed wastes Moderately drained and / or moderate fertility soils Small existing quarry or pit Sub-economic extractable mineral resource
Low	Attribute has a low quality, significance or value on a local scale. Degree or extent of soil contamination is minor on a local scale. Volume of peat and / or soft organic soil underlying route is small on a local scale.	Large historical and / or recent site for construction and demolition wastes Small historical and / or recent landfill site for construction and demolition wastes Poorly drained and / or low fertility soils. Uneconomically extractable mineral resource

Table 14.4: Criteria for Rating the Importance of Identified Hydrogeological Attributes (Box 4.3 (NRA 2008a))

Importance	Criteria	Typical Example
Extremely High	Attribute has a high quality or value on an international scale	Groundwater supports river, wetland or surface water body ecosystem protected by EU legislation e.g. Special Area of Conservation (SAC) or Source Protection Area (SPA) status
Very High	Attribute has a high quality or value on a regional or national scale	Regionally important aquifer with multiple well fields. Groundwater supports river, wetland or surface water body ecosystem protected by national legislation – NHA status Regionally important potable water source supplying >2500 homes Inner source protection area for regionally important water source
High	Attribute has a high quality or value on a local scale	Regionally Important Aquifer Groundwater provides large proportion of baseflow to local rivers Locally important potable water source supplying >1000 homes Outer source protection area for regionally important water source Inner source protection area for locally important water source
Medium	Attribute has a medium quality or value on a local scale	Locally Important Aquifer Potable water source supplying >50 homes Outer source protection area for locally important water source
Low	Attribute has a low quality or value on a local scale	Poor Bedrock Aquifer Potable water source supplying <50 homes

Table 14.5: Definition of Magnitude of Impact (Table 5.1 (NRA 2008a))

Magnitude of Impact	Description
Imperceptible	An impact capable of measurement but without noticeable consequences
Slight	An impact that alters the character of the environment without affecting its sensitivities
Moderate	An impact that alters the character of the environment in a manner that is consistence with existing or emerging trends
Significant	An impact which by its character, magnitude, duration or intensity alters a sensitive aspect of the environment
Profound	An impact which obliterates all previous sensitive characteristics

Table 14.6: Criteria for Rating Soils and Geology Impact Significance and Magnitude at EIA Stage (Table C4 (IGI 2013) and Box 5.1 (NRA 2008a))

Magnitude of Impact	Criteria	Typical Example
Large Adverse	Results in loss of attribute	Loss of high proportion of future quarry or pit reserves Irreversible loss of high proportion of local high fertility soils Removal of entirety of geological heritage feature Requirement to excavate / remediate entire waste site Requirement to excavate and replace high proportion of peat, organic soils and / or soft mineral soils beneath alignment
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	Loss of moderate proportion of future quarry or pit reserves Removal of part of geological heritage feature Irreversible loss of moderate proportion of local high fertility soils Requirement to excavate / remediate significant proportion of waste site Requirement to excavate and replace moderate proportion of peat, organic soils and / or soft mineral soils beneath alignment
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	Loss of small proportion of future quarry or pit reserves Removal of small part of geological heritage feature Irreversible loss of small proportion of local high fertility soils and / or high proportion of local low fertility soils Requirement to excavate / remediate small proportion of waste site Requirement to excavate and replace small proportion of peat, organic soils and/or soft mineral soils beneath alignment
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	No measurable changes in attributes
Minor Beneficial	Results in minor improvement of attribute quality	Minor enhancement of geological heritage feature
Moderate Beneficial	Results in moderate improvement of attribute quality	Moderate enhancement of geological heritage feature
Major Beneficial	Results in major improvement of attribute quality	Major enhancement of geological heritage feature

Table 14.7: Criteria for Rating Hydrogeological Impact Significance and Magnitude at EIA stage (Table C5 (IGI 2013))

Magnitude of Impact	Criteria	Typical Example
Large Adverse	Results in loss of attribute and/or quality and integrity of attribute	Removal of large proportion of aquifer Changes to aquifer or unsaturated zone resulting in extensive change to existing water supply springs and wells, river baseflow or ecosystems Potential high risk of pollution to groundwater from routine run-off Calculated risk of serious pollution incident during operation >2% annually
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	Removal of moderate proportion of aquifer Changes to aquifer or unsaturated zone resulting in moderate change to existing water supply springs and wells, river baseflow or ecosystems Potential medium risk of pollution to groundwater from routine run-off Calculated risk of serious pollution incident during operation >1% annually
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	Removal of small proportion of aquifer Changes to aquifer or unsaturated zone resulting in minor change to water supply springs and wells, river baseflow or ecosystems Potential low risk of pollution to groundwater from routine run-off Calculated risk of serious pollution incident during operation >0.5% annually
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	Calculated risk of serious pollution incident during operation <0.5% annually

Table 14.8: Rating of Environmental Impacts at EIA Stage (Table C6 (IGI 2013) and Box 5.4 (NRA 2008a))

		Magnitude of Impact			
		Negligible	**Small**	**Moderate**	**Large**
Importance of Attribute	**Extremely High**	Imperceptible	Significant	Profound	Profound
	Very High	Imperceptible	Significant / Moderate	Profound / Significant	Profound
	High	Imperceptible	Moderate / Slight	Significant / Moderate	Severe / Significant
	Medium	Imperceptible	Slight	Moderate	Significant
	Low	Imperceptible	Imperceptible	Slight	Slight / Moderate

14.2.4.4 Mitigation Measures, Residual Impacts and Final Impact Assessment

The third element of the recommended steps builds on the outcome of the preceding two elements, by identifying mitigation measures to address potential significant or profound impacts and then assessing the significance of any remaining residual impacts taking these measures into account. Mitigation by design measures which have been incorporated into the design for the Proposed Scheme are also considered in Section 14.5.

The final impact assessment includes a description of any residual impacts. The significance of any residual impact is determined based on the same methodology and reported.

14.3 Baseline Environment

14.3.1 Introduction

This Section describes the existing conditions and important features in terms of the land, soils, geology and hydrogeology within the study area of the Proposed Scheme. A regional overview is followed by a description of site-specific baseline conditions and a CSM. Features are then identified, and their importance ranked in accordance with the NRA Guidelines (NRA 2008a).

14.3.2 Regional Overview

The regional geomorphology, topography, soils and subsoils, bedrock geology and hydrogeology are discussed in this Section for the majority of County Dublin, including the City Centre and extends north to Swords and to Bray in County Wicklow in the south of the region and west towards Lucan and Blanchardstown.

14.3.2.1 Regional Topography and Geomorphology

The topography of the region is dominated by the Wicklow Mountains to the south with undulating topography to the north, west and east with localised highs generally synonymous with outcropping rock or near surface bedrock. There is a gradual drop in elevation across the region from west to east approaching the coast.

The landscape of the region principally reflects the erosional and depositional legacy of the last period of glaciation, which ended some 10,000 years ago following the Devensian geological period. Glacial erosion of pre-existing topographic features and deposition of thick glacial drift deposits, mainly till (boulder clay), resulted in a rather subdued post-glacial topography.

The post-glacial landscape also reflects the effects of fluvial (river) processes that have altered the topography, with the River Liffey and its tributaries dominating the region, since the ice sheet retreat. The topography of the area reflects the geomorphology, showing topographic lows moving eastwards to the sea near Dublin City, becoming steeper to the west, north and south towards the Dublin and Wicklow Mountains.

There are a large number of geomorphology features across the region including mega scale glacial lineation in the north of the region, streamlined bedrock, numerous meltwater channels, hummocky sands and gravel deposits, drumlins, eskers and glaciofluvial terraces throughout the region (refer to Figure 14.1 in Volume 3 of this EIAR).

The post-glacial landscape also reflects the effects of fluvial (river) processes that have altered the topography, albeit only to a small extent in the region, since the ice sheet retreat. The coastline within the region is characterised by sandy beaches and rock outcrops.

The land uses in the region are mainly comprised of urban developments including but not limited to; industrial, commercial, residential and recreational. Moving away from the City Centre there are also marine, agricultural and forested areas in the region.

14.3.2.2 Regional Soils (Teagasc Classification)

Soils comprise the unconsolidated geological deposits which overlie the subsoil (i.e. the topsoil). The main soils within the region, as classified by Teagasc (Teagasc *et al*. 2017) are presented on Figure 14.2 in Volume 3 of this EIAR and have been listed in Table 14.9. The majority of Dublin is underlain by made ground with areas of alluvial, estuarine and marine deposits present that may be associated with recent and ancient water bodies. To the north of the region, there are soils which are deep and well drained as well as poorly drained soils derived from basic parent material. To the south of the region the soil is derived from acidic material.

Table 14.9: Summary of Soil Types Within the Region

Soil Code	Description	Location
AeoUND	Aeolian undifferentiated	Coast
AlluvMin	Alluvial (min)	Along river courses and meltwater channels
AminDW	Deep well drained mineral soil (mainly acidic)	South towards Bray
AminPD	Mineral poorly drained (mainly acidic)	South towards Bray
AminPDPT	Peaty Gleys Acidic	Near Wicklow Mountains
AminSP	Surface water gleys / Ground water gleys shallow	South towards Bray
AminSW	Shallow well drained mineral soil (mainly acidic)	South towards Bray
AminSRPT	Shallow rocky peaty, non-peaty mineral complexes (mainly acidic)	Near Wicklow Mountains
BktPT	Blanket Peat	Near Wicklow Mountains
BminDW	Deep well drained mineral soil (mainly basic)	North near Swords
BminPD	Mineral poorly drained (mainly basic)	North near Swords
BminPDPT	Peaty gleys basic parent materials basic	Near Wicklow Mountains
BminSP	Surface water gleys/ groundwater gleys shallow	South towards Newcastle
BminSPPT	Peaty gleys shallow	Near Wicklow Mountains
BminSRPT	Lithosols peats	Near Wicklow Mountains
BminSW	Renzinas / Lithosols	Dublin outskirts
Cut	Raised bog cutaway / cutover	Near Wicklow Mountains
FenPT	Fenpeat	Near Wicklow Mountains
Lac	Lacustrine sediments	South near Wicklow Mountains
Made	Made ground	Dublin City and outskirts
MarSands	Marine sands and gravels	Coast
MarSed	Marine / estuarine sediments	Coast
Scree	Scree	Near Wicklow Mountains

14.3.2.3 Regional Subsoils (GSI Quaternary Classification)

Superficial deposits (subsoil) comprise the unconsolidated geological deposits which overlie the solid geology. The subsoils within the region, as classified by the GSI Quaternary mapping (GSI 2016a) are presented on Figure 14.3 in Volume 3 of this EIAR and have been listed in Table 14.10.

During the Pleistocene epoch of the Quaternary, two glaciations covered County Dublin and County Wicklow which gave rise to the deposition of glacial till. Typically, during the ice advance, boulder clays were deposited sub-glacially as lodgement till over the eroded bedrock surface, whilst moraine granular deposits were laid down at the glacier margins.

Subsequently, with the progressive retreat of the ice sheets from the region, granular fluvio-glacial deposits were laid down in places by melt waters discharging from the front of the glacier which are generally encountered as sand and gravel lenses within the glacial till deposits. The glacial deposits can exhibit significant lateral and vertical variations in grain size distributions over short distances.

This glacial till is the predominant subsoil of the region and described as till derived from limestones. The subsoils of the region may also be comprised of made ground where major development has occurred. More recent alluvial deposits (silts and clays and sands and gravels) may be present along historic and recent watercourses.

To the east of the region, along the coast the subsoils consist of estuarine silts and clays and marine beach sands. Outcropping and sub cropping rock and till derived from granites and metamorphic rock are present to the south and west of the region where the topography rises towards the Dublin Mountains and Bray.

Table 14.10: List of Subsoils (Quaternary) Within the Region

Soil Type	Description	Location
A	Alluvium	Along river channels and meltwater channels
Ag	Alluvium (gravelly)	Along river channels and meltwater channels
As,	Alluvium (sandy)	Along river channels and meltwater channels
Asi	Alluvium (silty)	Along river channels and meltwater channels
BktPt	Blanket Peat	Near Wicklow Mountains
Cut	Cut over raised peat	Near Wicklow Mountains
AcEsk	Eskers comprised of gravels of acidic reaction	Tallaght / Ballymount
GCh	Gravels derived from chert	North West Dublin
GLPSsS	Gravels derived from Lower Paleozoic sandstones and shales	Howth
GLs	Gravels derived from limestones	Dublin City
GMp	Gravels derived from metamorphic rocks	South towards Bray
GGr	Gravels derived from granite	South Dublin
Rck	Bedrock outcrop or subcrop	Localised pockets within Dublin City / near Wicklow Mountains
Scree	Scree	Near Wicklow Mountains
L	Lacustrine sediments	South near Wicklow Mountains
Mbs	Marine beach sands	Coast
Mesc	Estuarine silts and clays	Portmarnock
TdlMr	Tidal Marsh	Bull Island
IrSTCSsS	Irish Sea Till derived from Cambrian sandstones and shales	Bray South
IrSTLPSsS	Irish Sea Till derived from Lower Paleozoic sandstones and shales	Bray South
IrSTLs	Irish Sea Till derived from limestones	South towards Bray
TCSsS	Till derived from Cambrian sandstones and shales	Bray South
TGr	Till derived from granites	South Dublin
TLPSsS	Till derived from Lower Paleozoic sandstones and shales	South Dublin
TLs	Till derived from limestones	Dublin City
TMp	Till derived from metamorphic rocks	Near Wicklow Mountains
TQz	Till derived from quartzites	South towards Bray
Ws	Windblown sands	Coast
Wsd	Windblown sands and dunes	Coast
Dam	Dam	Tallaght
Embankment	Embankment	Sandyford
Landfill	Landfill	Near Blanchardstown
Urban	Urban (made ground)	Dublin City and outskirts

14.3.2.4 Regional Bedrock Geology

The bedrock geology types of the region, as classified by the GSI 1:500,000 Bedrock Geology Map (GSI 2018) are presented on Figure 14.4 in Volume 3 of this EIAR and have been listed in Table 14.11. The region is predominantly underlain by Carboniferous Limestones. The majority of the Dublin City area was a deep marine basin known as the Dublin Basin where these sedimentary rocks were deposited.

To the south of the region, stretching from Dún Laoghaire on the coast in a south to south-west direction and located beneath much of the Dublin and Wicklow Mountains, are the older Caledonian granites known as the Leinster Granite. This is a large intrusion of igneous rock which occurred during the Devonian Period mountain building event known as the Caledonian Orogeny.

The oldest rocks in the region are the Cambrian and Ordovician Metasediments which extend from Loughlinstown towards Bray with the Cambrian Bray Head Formation dominating the Bray to Greystones area and synonymous with the Quartzite of the Sugar Loaf.

The structural geology within the region is highly variable and complex. A series of parallel faults running mainly in a north-west to south-east orientation are indicated in the north of the region between Blanchardstown and Dublin Airport. Additional faulting in this area is indicated in a north / north-west to south / south-east direction with associated fold axes both synclinal and anticlinal running in a north-east to south-west direction. The contact between the Lucan Formation and the Leinster Granite is characterised by a west-east trending fault. The south of the region is dominated by metamorphic intrusions and north-west / south-east trending faults within the Leinster Granite. The south-eastern section of the region around Bray and Shankill is heavily faulted and folded with a number of west-east thrust faults and numerous north-west / south-east synclinal fold axis.

The depth to bedrock within the region ranges from one metre below ground level (mBGL) in the south-west of the region near Tallaght and the north-west near Blanchardstown to potentially greater than 25mBGL in the Dublin City Centre area and up to 45mBGL in Dublin Port. The bedrock level ranges from 80m above Ordnance Datum (mOD) towards the mountainous and inland parts of the region to approximately -40mOD near Dublin Port.

Table 14.11: Rock Formation Within the Region.

Geological Period	Formation	Description	Location
Carboniferous	Visean basinal limestone "Calp"	(Calp) Dark-grey argillaceous and cherty limestone and shale	Central and north County Dublin
	Waulsortian mudbank	Pale grey massive limestone	North-west near the N2 and N3 National Roads, Malahide and Swords
	Courceyan Limestone	Argillaceous dark-grey bioclastic limestone and subsidiary shale	North-west
	Upper Devonian -Lower Carboniferous Old Red Sandstone	Sandstone, conglomerate and siltstone	North of Swords
Caledonian Orogeny (Mountain Building Era)	Caledonian Granite	Granite, granodiorite	South near Bray
Silurian	Silurian sandstone, greywacke and shale	Mudstone, greywacke and conglomerate	South-west
Ordovician	Middle to Upper Ordovician basic volcanics	Basalt-andesite, tuff, slate and mudstone	North-west
	Lower to Middle Ordovician slate	Slate, schist and minor greywacke	South-west
	Lower to Middle Ordovician acid volcanics	Rhyolite and rhyolitic tuff	South-west
	Lower to Middle Ordovician basic volcanics	Basalt- andesite, tuff and shale	South-west
Cambrian	Cambrian Greywacke	Greywacke and Shale	Bray

14.3.2.5 Regional Aquifer Type and Classification

The aquifers of the region (groundwater bearing bodies), as classified by the National Draft Bedrock Aquifer Map (GSI 2019b) are presented on Figure 14.5 in Volume 3 of this EIAR and have been listed in Table 14.12. The GSI (GSI 2019b) has devised a system for classifying the aquifers in Ireland based on the hydrogeological characteristics, size and productivity of the groundwater resource. The aquifer classes and sub-classes are shown in the National Draft Bedrock Aquifer Map. There are three principal types of aquifer, corresponding to whether they are major, minor or unproductive resources, whereby:

- Regionally Important Aquifers are capable of supplying regionally important abstractions (e.g. large public water supplies), or excellent yields (>400m cubed per day (m^3/d));
- Locally Important Aquifers are capable of supplying locally important abstractions (e.g. smaller public water supplies, group schemes), or good yields ($100m^3/d$ to $400m^3/d$); and

- Poor Aquifers are capable of supplying small abstractions (e.g. domestic supplies), or moderate to low yields (<100m^3/d).

The lower permeability glacial till soils which overlay the bedrock (gravelly clay / boulder clay), slow infiltration and restrict recharge to bedrock aquifers. The glacial till is not classified as an aquifer by the GSI.

Under the WFD, the regional hydrogeology has been assessed using the GSI groundwater viewer (GSI 2019b). The regional groundwater bodies (GWB) in the area are (refer to Figure 14.5 in Volume 3 of this EIAR):

- Dublin GWB;
- Swords GWB;
- Kilcullen GWB; and
- Wicklow GWB.

Table 14.12: Aquifer Types Within the Region

Aquifer Type	Location	Description	Code
Locally Important	North and centre of the region	Bedrock which is moderately productive only in local zones	(Ll)
	Bray (south-eastern extent of the region	Gravel	(Lg)
Poor Aquifer	Most of southern extent of the region	Bedrock which is generally unproductive except for local zones	(Pl)

14.3.2.6 Regional Aquifer Vulnerability

Aquifer vulnerability of a groundwater body is the term used to describe the intrinsic geological and hydrogeological characteristics which determine the ease with which a groundwater body may be contaminated by human activities.

The vulnerability is determined by the travel time and the attenuation capacity of the overlying deposits. The groundwater vulnerability is determined mainly by the permeability and thickness of the subsoils that underlay the topsoil. For example, bedrock with a thick, low permeability overburden is less vulnerable than bedrock with a thin high permeability, gravel overburden.

The GSI aquifer vulnerability classification guidelines (GSI 2019b), which are outlined in Table 14.13, demonstrate that the aquifers are most at risk in areas where subsoils are thin or absent and where karst features such as swallow holes are present. This is due to the ability of potential contaminants to reach the aquifer in a relatively short period and with little or no contaminant attenuation due to the thin or absent overburden. The regional groundwater vulnerability varies significantly across the region, ranging from Rock at Surface (X) to Low (L) vulnerability.

Table 14.13: Aquifer Vulnerability (GSI 2019b)

Vulnerability Rating	Hydrogeological Conditions				
	Subsoil Permeability (Type) and Thickness			Unsaturated Zone	Karst Features
	High Permeability (Sand / Gravel)	Moderate Permeability (e.g. Sandy Subsoil)	Low Permeability (e.g. Clayey Subsoil, Clay, Peat)	Sand / Gravel Aquifers Only)	(<30m Radius)
Rock at or close to surface (X)	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Extreme (E)	0m – 3.0m	0m – 3.0m	0m – 3.0m	0m – 3.0m	Not applicable
High (H)	>3.0m	3.0m – 10.0m	3.0m – 5.0m	>3.0m	Not applicable
Moderate (M)	Not applicable	>10.0m	5.0m – 10.0m	Not applicable	Not applicable
Low (L)	Not applicable	Not applicable	>10.0m	Not applicable	Not applicable

14.3.2.7 Regional Recharge

Recharge is the amount of rainfall that replenishes the aquifer. It is a function of the effective rainfall, the permeability and thickness of the subsoil and the aquifer characteristics. The GSI Groundwater Recharge mapping for the region indicates annual groundwater recharge across the region ranges from approximately 1 millimetre per year (mm/yr) to 600mm/yr as shown on Figure 14.6 in Volume 3 of this EIAR.

14.3.2.8 Regional Groundwater Abstractions

Groundwater resources describe any large spring, well or boreholes which are used as a groundwater abstraction source by domestic, agricultural, commercial, industrial, local authority or group water scheme users.

The GSI keeps a record of groundwater wells drilled (GSI 2019b). However, the record does not state which wells are currently used for abstraction.

In addition to these abstractions, Dublin City Council (DCC) also maintains a database of groundwater and surface water abstractions. However, this data is not available to the public. The EPA has also launched a register of water abstractions, whereby people who abstract 25m^3 (cubic metres) of water or more per day are required to register their water abstraction. However, this data is not available to the public.

Source Protection Zones (SPZ) reports have been produced by the GSI (GSI 2019b) in conjunction with the EPA for groundwater sources, particularly public water supplies, group water schemes or important industrial supplies. The reports aim to guide development planning and regulation to provide protection to groundwater sources. To date no SPZ reports have been produced with regard to any sites within the study area.

Groundwater is not used extensively for residential or industrial purposes in the area. The majority of potable water used within the region is abstracted elsewhere and piped to the region, and therefore groundwater abstraction is not considered further in this Chapter.

14.3.2.9 Groundwater Quality and Levels

Based on professional experience and previous ground investigations in the area, groundwater levels are generally within 5m of the surface in Dublin City and are closer to the surface near rivers and streams. Historical groundwater monitoring is available from a monitoring borehole at the GSI Beggar's Bush Office, Dublin 4 (monitored from 1990 to 2000). Groundwater level monitoring has commenced at Beggar's Bush since August 2018 with the data available online (GSI 2019e). Beggar's Bush lies approximately 2km south-east of the City Centre. There is an inactive EPA monitoring borehole located in Goatstown, Dublin 14 which is approximately 6km south of the City Centre (monitored from 1997 to 2006). The results from both monitoring points show that the groundwater levels have a seasonal range over their entire monitoring record of 0.55m and 0.27m respectively.

The hydro-chemical analyses of groundwater within the Dublin GWB are available at the EPA Ryewater monitoring stations at Carton House, near Maynooth, County Kildare. The limestone groundwater quality is very hard water (350 milligrams per litre (mg/l) to 480mg/l of Calcium carbonate ($CaCO_3$)), with a high alkalinity (300mg/l to 350mg/l ($CaCO_3$)) and conductivities (550 micro siemens per centimetre (µS/cm) to 900µS/cm). The pH is relatively neutral ranging from 6.5 to 7.5.

Further to the south where the region is underlain by granites of the Maulin Formation, the groundwater is softer and less mineralised with hardness values of 100mg/l ($CaCO_3$) to 150mg/l ($CaCO_3$), alkalinity of <50mg/l ($CaCO_3$) and conductivity values of 300µS/cm to 500µS/cm and a lower pH range of 6 to 7.

14.3.2.10 Regional Hydro-Ecology Designated Sites

Designated protected sites within Ireland compiled by the National Parks and Wildlife Service (NPWS) such as Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) could be groundwater dependent habitats and therefore an impact on the hydrogeology could result in an impact on a designated site. Further information regarding the designated sites within the region are provided in Chapter 12 (Biodiversity). Only the hydrogeology related impacts on groundwater dependant designated sites are assessed within this Chapter.

14.3.2.11 Regional Geological Heritage

The National Parks & Wildlife Service identifies the Natural Heritage Area (NHA) as the basic designation for wildlife. This is an area considered important for the habitats present or which holds species of plants and animals whose habitat needs protection. The GSI is compiling a list of geological / geomorphological sites in need of protection through NHA designation (not available at the time of writing). However, these sites will be compiled from the existing database of County Geological Sites (CGS) (GSI 2019c), as listed in Table 14.14.

Table 14.14: Designated Sites Within the Region

Designation Code	Designated Site
CGS, SPA	North Bull Island
CGS	Glasnevin Cemetery
CGS	Phoenix Park
CGS	River Poddle
CGS	Greenhills Esker
CGS	Dodder Terraces
CGS	Belgard Quarry
CGS	Killiney Bay
CGS	Enniskerry Delta
CGS	GPO (General Post Office)
CGS	Museum Building, Trinity College Dublin
CGS	Oscar Wilde Statue
CGS	51 St. Stephens Green
CGS	Dublin City Walls
CGS	Temple Bar Street Well
CGS	Guinness Wells
CGS	Kippure
CGS	Lucan Esker
CGS	Liffey Valley Centre road sections
CGS	N4 Lucan cutting
CGS	Ballinascorney Quarry
CGS	Newcastle Buried channel
CGS	Carrickgollogan
CGS	Ballycorus
CGS	Killiney Hill
CGS	White Rock, Killiney
CGS	Ballybetagh Bog
CGS	Dalkey Island
CGS	Killiney Bay
CGS	The Scalp
CGS	Three Rock Mountain
CGS	Blackrock Breccia
CGS	Dalkey Hill
CGS	Murphystone Quarry
CGS	Enniskerry Delta
CGS	Glencullen River
CGS, pNHA	River Dargle Valley
CGS, SAC	Bray Head

14.3.3 Site Specific Environment

The following Section discusses the site-specific conditions (refer to Figure 14.7 to Figure 14.15 in Volume 3 of this EIAR) within the study area for the Proposed Scheme as defined in Section 14.2.1. Where applicable the importance of the attributes for which the impact of the Proposed Scheme is to be assessed are reported in this Section.

14.3.3.1 Current and Historic Land Use

The current and historic land use is discussed to give context to any potential changes to land, soils, geology and hydrogeology that have the potential to influence the importance of a feature and the magnitude of any impacts. The current land use is based on current aerial imagery and mapping available from Ordnance Survey Ireland (OSI) (OSI 2022), Google (Google 2022), Bing (Bing 2022) and the Corine Land Cover maps (EPA 2018). The historic land use is based on the following OSI (OSI 2022) historic aerial imagery and historic maps:

- OSI 6-inch mapping produced between 1837 and 1842;
- OSI 25-inch mapping produced between 1888 and 1913;
- OSI 6-inch Cassini mapping produced between 1830 and 1930s;
- OSI 1995 aerial photography;
- OSI 2000 aerial photography; and
- OSI 2005 aerial photography.

14.3.3.1.1 Liffey Valley to Le Fanu Road

The OSI 6-inch, 25-inch and 6 inch Cassini mapping shows this sub-section of the Proposed Scheme as predominately rural. The current road alignment is different to the original in places.

The OSI 1995 aerial photograph shows the transition from a rural environment to an urban environment. There are multiple residential areas located within the study area. The road has been altered to its present day alignment and roundabouts have been added along the Ballyfermot Road. The M50 has also been constructed, crossing the section at Coldcut Road.

The OSI 2000 aerial photograph shows the construction of the Liffey Valley Shopping Centre and Fonthill Road, which are located at the start of this subsection. There appear to be no further significant developments in this section.

The OSI 2005 aerial photograph shows no significant developments within the study area.

The satellite imagery provided by Google Maps (2022) shows no significant developments within the study area. The Corine Land Cover 2018 classifies the land use within the study area from Fonthill Road to the junction with Coldcut Road as industrial or commercial units. From Coldcut Road, across the M50 to the start of Cherry Orchard Industrial Estate at the junction of Coldcut Road with Ballyfermot Road the land use is classified as discontinuous urban fabric. From Ballyfermot Road to approximately Cleggan Park the land use is once again classified as industrial or commercial units. From Cleggan Park to Le Fanu Road is classified as discontinuous urban fabric.

14.3.3.1.2 Le Fanu Road to Sarsfield Road

The OSI 6-inch, 25-inch and 6 inch Cassini mapping shows this sub-section of the Proposed Scheme as predominately rural. The current road alignment is different to the original in places. There are quarries and gravel pits and steep slopes shown in the area of Markievicz Park.

The OSI 1995 aerial photograph shows this sub-section as now being predominantly urban as residential areas have been developed throughout. The road now matches its current alignment and the Chapalizod Bypass has been constructed. Green areas are seen along the south banks of the River Liffey.

The OSI 2000 aerial photograph shows no significant developments within the study area.

The OSI 2005 aerial photograph shows no significant developments within the study area.

The satellite imagery provided by Google Maps (2022) shows no significant developments within the study area.

The Corine Land Cover 2018 classifies the land use within the study area from Le Fanu Road to Sarsfield Road as discontinuous urban fabric.

14.3.3.1.3 Sarsfield Road to City Centre

The OSI 6-inch mapping shows this sub-section of the Proposed Scheme as predominately rural up to James's Street where most of the modern day street layout is present.

The 25-inch mapping shows that much of the presence urbanisation in the sub-section had occurred by the production of the map for this sub-subsection. A significant development is the Inchcore Railway Works and the Great Southern and Western Railway. The St James' Gate Brewery has also been developed. A tramway is seen traversing from the tram depot on Emmet Road to Cornmarket. A lime kiln is located opposite Turvey Avenue. A distillery is located on Thomas Street where the present National College of Art and Design is situated.

The 6-inch Cassini mapping shows further urban development in this sub-section. Several existing features have been redeveloped, such as the conversion of Richmond barracks into a school and the South Dublin Union Workhouse into St Kevin's Institution. The tramway has also been removed. The Irish National War Memorial Garden has also been constructed.

The 1995 aerial photograph shows further residential developments within the study area.

The 2000 aerial photograph shows no significant developments within the study area.

The 2005 aerial photograph shows no significant developments within the study area.

The satellite imagery provided by Google Maps (2022) shows no significant developments within the study area outside of the development of the New Children's Hospital site at St James' Hospital.

The Corine Land Cover 2018 classifies the land use within the south of the study area from the junction of Ballyfermot Road and Sarsfield Road to the junction of Sarsfield Road and Inchicore Road as discontinuous urban fabric and industrial or commercial units. The land use in the north of the study area from the junction of Ballyfermot Road and Sarsfield Road to the junction of Sarsfield Road and Inchicore Road is predominantly green urban areas with exception of Father Bidone Court Apartments.

From the junction of Sarsfield Road with Inchicore Road to the junction of Inchicore Road with South Circular Road the land use of the study area is classified as discontinuous urban fabric. The land use of the study area from South Circular Road to the City Centre is classified as continuous urban fabric except for the grounds of Royal Hospital Kilmainham and Saint Patricks University Hospital to the north of the Proposed Scheme which is classified as discontinuous urban fabric.

14.3.3.2 Geomorphology and Topography

The geomorphology and topography are discussed in order to give context to any potential changes to land, soils, geology, and hydrogeology that could influence the importance of a feature and the magnitude of any impacts. The geomorphology (GSI 2016a) and the topography are shown on Figure 14.7 in Volume 3 of this EIAR.

14.3.3.2.1 Liffey Valley to Le Fanu Road

The Proposed Scheme commences at the Fonthill Road which according to the OSI 10m contours is at an elevation between 60mOD and 70mOD and gradually falls to approximately 40mOD to 50mOD at Le Fanu Road.

There are no notable geomorphological features within this section of the study area.

14.3.3.2.2 Le Fanu Road to Sarsfield Road

The topography continues to fall gradually reaching 40mOD just before the junction with Kylemore Road and almost 20mOD at the junction of Ballyfermot Road and Sarsfield Road.

As the Proposed Scheme approaches the junction with Kylemore Road, the north of the study area intersects a small area of hummocky sand and gravel at Colepark Drive.

14.3.3.2.3 Sarsfield Road to City Centre

The topography continues to fall gradually reaching a low below 10mOD just before the junction between Old Kilmainham and Brookfield Road before rising slightly again to remain between 10mOD and 20mOD to the end of the Proposed Scheme.

The study area intersects a small area of hummocky sand and gravel between the junction of Sarsfield Road and Inchicore Road and the junction of Grattan Crescent and Emmet Road. A meltwater channel along the north of the study area from the junction of Grattan Crescent and Emmet Road to approximately the start of James Street (the present-day River Camac). There are areas of hummocky sand and gravel within the study area south of Thomas Street. As the study area approaches the City Centre it begins to intersect with the glacial meltwater channel associated with the River Liffey.

14.3.3.3 Soils (Teagasc Soil Classification)

The majority of the soils expected to be encountered within the study area are made ground comprising varying forms of hard standing materials including road pavements and footpaths. However, there are topsoil and other soils present within the study area for which there are a number of classifications on the Teagasc Soil Map (Teagasc *et al*. 2017). The main soils within the study area, as classified by Teagasc (Teagasc *et al*. 2017) are presented on Figure 14.8 in Volume 3 of this EIAR and are listed in Table 14.15 along with their importance with respect to drainage and fertility as determined by Box 4.1 in the NRA Guidelines (NRA 2008a). Where these soils are important features with respect to possible soft soils or contamination their importance is detailed in Section 14.3.3.8 and Section 14.3.3.9.

14.3.3.3.1 Liffey Valley to Le Fanu Road

The underlying soils within the study area from Fonthill Road to the M50 are classified as poorly drained (mainly basic and deep well drained (mainly basic). From the M50 to Le Fanu Road the underlying soils are classified as made ground.

14.3.3.3.2 Le Fanu Road to Sarsfield Road

From Le Fanu Road to Sarsfield Road the underlying soils are predominately made ground with the exception of poorly drained (mainly basic and deep well drained (mainly basic) in the north of the study area from Kylemore Road to Sarsfield Road and shallow well drained (mainly basic) associated with the hummocky sands and gravel geomorphic feature at Colepark Drive and then at Markievicz Park.

14.3.3.3.3 Sarsfield Road to City Centre

From Sarsfield Road to City Centre the study area is predominantly underlain by made ground. There are areas of poorly drained (mainly basic) associated with the green areas in the north of the study area, such as Longmeadow Pitch and Putt and Liffey Gaels GAA Club. The Irish War Memorial Gardens is underlain by both topsoil and alluvium associated with the River Liffey. There is again poorly drained (mainly basic) and deep well drained (mainly basic) soils at Grattan Crescent and alluvium associated with the Camac River.

Table 14.15: Soils Within the Study Area

Soil Type	Notes / Description	Location	Importance	Justification for Importance Rating
Made Ground - Made	Associated with urban development	Widespread	Low	Poorly drained and / or low fertility soils
Topsoil - BminPD	Poorly drained (Mainly Basic)	Widespread in green areas	Low	Poorly drained and / or low fertility soils
Alluvium - AlluvMIN	Typically found along current and historic watercourses	River Camac	Medium	Moderately drained and / or moderate fertility soils
Topsoil - BminSW	Shallow well drained (Mainly basic)	Colepark Drive, Markievicz Park	High	Well drained and / or high fertility soils
Topsoil - BminDW	Deep well drained (Mainly basic)	Widespread in green areas	High	Well drained and / or high fertility soils

14.3.3.4 Subsoil Deposits (GSI Quaternary Classification)

Superficial deposits (subsoil) comprise the unconsolidated geological deposits which overlie the solid geology. The subsoils within the study area, as classified by the GSI Quaternary mapping (GSI 2016a) are presented on Figure 14.9 in Volume 3 of this EIAR and are listed in Table 14.16 along with their importance with respect to feature quality and significance, as determined by Box 4.1 of the NRA Guidelines (NRA 2008a). Where these subsoils are important features with respect to possible soft soils or contamination, their importance is detailed in Section 14.3.3.8 and Section 14.3.3.9.

The main subsoils encountered across the study area are predominately glacial tills. Additionally, there are areas of made ground (Urban), alluvial deposits, gravels and shallow bedrock as discussed below.

14.3.3.4.1 Liffey Valley to Le Fanu Road

The subsoils encountered within the study area for this section of the Proposed Scheme are glacial tills derived from limestone.

14.3.3.4.2 Le Fanu Road to Sarsfield Road

The subsoils encountered within the study area for this section of the Proposed Scheme are predominately glacial tills derived from limestone. There are gravels at Colepark Drive, a small area of made ground (Urban) at Ballyfermot College of Further Education, and shallow rock at Markievicz Park. The Chapelizod Bypass to the north of the Proposed Scheme is made ground (Urban).

14.3.3.4.3 Sarsfield Road to City Centre

The subsoils encountered within the study area for this section of the Proposed Scheme are predominately either glacial tills derived from limestone or made ground (Urban). There is alluvium associated with the River Camac and River Liffey to the north, and glacial gravels in Inchicore and south of Thomas Street.

Table 14.16: Subsoils Within the Study Area

Subsoil Type	Description	Location	Importance	Justification for Importance Rating
Made Ground - Urban	Associated with urban development	Widespread	Low	Low value on a local scale
Alluvium - A	Typically found along current and historic watercourses	River Camac	Low	Low value on a local scale
Glacial gravels - GLs	Gravels derived from limestones	Colepark Drive	Low	Low value on a local scale
Glacial till - TLs	Till derived from limestones	Widespread	Low	Low value on a local scale
Rock - Rck	Bedrock outcrop or subcrop	Markievicz Park	Low	Low value on a local scale

14.3.3.5 Bedrock Geology

The bedrock geology of the study area, as classified by the GSI 1:100,000 Bedrock Geology Map (GSI 2018) are presented on Figure 14.10 in Volume 3 of this EIAR and have been listed in Table 14.17 along with their importance with respect to feature quality and significance as determined by Box 4.1 in the NRA Guidelines (NRA 2008a). Where the bedrock is an important feature with respect to economic geology its importance is detailed in Section 14.3.3.10.

The underlying bedrock of the study area for the Proposed Scheme comprises the Lucan Formation (locally known as Calp Limestone). A summary of the bedrock geology along the Proposed Scheme is presented in Table 14.17.

Bedrock is noted as outcropping at Markievicz Park.

No major structural bedrock features were identified within the study area.

Table 14.17: Rock Formations Within the Study Area

Formation	Description	Location	Importance	Justification for Importance Rating
Lucan	(Calp) Dark Limestone and shale - Carboniferous	Widespread	Low	Low value on a local scale

14.3.3.6 Ground Investigation

A summary of the ground conditions encountered by historical ground investigations adjacent to the Proposed Scheme are presented in Table 14.18 to Table 14.20.

The data presented in the tables are indicative and strata depth and presence will vary by location. The historical ground investigation data was obtained for purposes and projects other than this EIAR. Therefore, although the historical ground investigation data provides useful indication of ground conditions, the quality of the data cannot be verified.

Table 14.18: Summary of Ground Conditions Expected to be Encountered by the Proposed Scheme from Liffey Valley to Le Fanu Road

Strata	General Extent / Location	Depth Range (mBGL)	Thickness of Strata (m)
Topsoil	Green areas – including parks, large estates and golf courses	0	0.2 – 0.4
Made Ground	Throughout	0 – 0.4	0.3 – 1.90
Glacial Till (Brown and Black Boulder Clay with lenses of fluvioglacial sands and gravels)	Widespread	0.2 – 1.90	Not proven

Table 14.19: Summary of Ground Conditions Expected to be Encountered by the Proposed Scheme from Le Fanu Road to Sarsfield Road

Strata	General Extent / Location	Depth Range (mBGL)	Thickness Range (m)
Topsoil	Green areas – including parks, large estates and golf courses	0	0.4 – 0.6
Made Ground	Throughout	0 – 0.4	1.1 – 17
Glacial Till (Brown and Black Boulder Clay with lenses of fluvioglacial sands and gravels)	Widespread	0.6 – 1.1	Not proven

Table 14.20: Summary of Ground Conditions Expected to be Encountered by the Proposed Scheme from Sarsfield Road to City Centre

Strata	General Extent / Location	Depth Range (mBGL)	Thickness Range (m)
Topsoil	Green areas – including parks, large estates and golf courses	0	0.1 – 0.6
Made Ground	Throughout	0 – 0.4	0.5 – 6.9
Glacial Till (Brown and Black Boulder Clay with lenses of fluvioglacial sands and gravels)	Widespread	0.2 – 5.5	5.7 – 7.5
Bedrock	Widespread	11.0 – 13.0	Not proven

14.3.3.7 Karst

Karst is a type of geological feature characterised by caves, caverns and other types of underground drainage resulting from the dissolution of the underlying bedrock. This typically occurs in areas of high rainfall with soluble rock.

There are no karst features identified within the study area in the GSI karst database (GSI 2019b). Consequently, the risk of karst is deemed negligible due to the geology of the region not being known to contain karst features and will not be further assessed.

14.3.3.8 Soft and / or Unstable Ground

Soft soils consist of peat, fine grained alluvium or very soft cohesive material. Their presence within the study area could result in an impact if they require excavation and are therefore considered important features. Various sources of information were consulted in establishing these areas within the study area namely:

- Teagasc soil map (Teagasc *et al*. 2017);
- GSI Quaternary Map (GSI 2016a);
- Ground investigation data;
- Scheme walkover survey; and
- GSI Landslide Events (GSI 2017).

The GSI Landslide Events (GSI 2017) shows no recorded landslide events within the study area and therefore unstable ground is not considered further in this assessment.

The soft soils identified within the study area are detailed in Table 14.21 along with their importance as determined by Box 4.1 of the NRA Guidelines (NRA 2008a).

Table 14.21: Soft Soils Within the Study Area

Feature	Description	Location	Importance	Justification for Importance Rating
Alluvium - AlluvMIN (soils) / A (subsoils)	Typically found along current and historic watercourses	River Camac	Low	Volume of soft soil underlying the study area is small and of a local scale.

14.3.3.9 Contaminated Land

Considering the location of the Proposed Scheme in the urban environment, there are likely to be some sources of contamination within the made ground throughout the study area. Therefore the assessment of contaminated land is focused on the footprint and directly on either side of the Proposed Scheme unless there is likely to be a pathway connecting the possible source of contamination to the footprint of the Proposed Scheme.

Various sources of information were consulted in assessing the Proposed Scheme for locations of potential contaminated land:

- Corine Land Cover maps (EPA 2018);

- Teagasc soil map (Teagasc et al. 2017);
- EPA mapping (EPA 2022b);
- OSI mapping (OSI 2022);
- The design information as listed in Section 14.2.3.3; and
- Local authority archives and databases as listed in Table 14.1.

The known potential sources of contamination relevant to the Proposed Scheme identified within the study area are detailed in Table 14.22 along with their importance as determined by Box 4.1 of the NRA Guidelines (NRA 2008a).

Table 14.22: Summary of Potential Sources of Contaminated Land Adjacent to the Proposed Scheme

Feature	Description	Location	Importance	Justification for Importance rating
Quarry	Disused gravel pit (OSI 25 Inch Mapping)	Markievicz Park.	Medium	Degree or extent of soil contamination is moderate on a local scale
Flour Mill	Flour Mill (OSI 6 inch mapping)	Old Kilmainham Road and Mount Brown	Medium	Degree or extent of soil contamination is moderate on a local scale
Graveyard	Graveyard (OSI 6 inch, 25 Inch and 6 inch Cassini mapping)	Junction of Bow Lane West and James' Street and the west end of Thomas Street.	Medium	Degree or extent of soil contamination is moderate on a local scale
Saw Mill	Saw Mill (OSI 6 inch Mapping)	Oliver Bonds Street	Medium	Degree or extent of soil contamination is moderate on a local scale
Lime Kiln	Lime Kiln (OSI 25 Inch Mapping)	South of Emmet Road and Luby Road Junction.	Medium	Degree or extent of soil contamination is moderate on a local scale
Distillery	Distillery (OSI 25 Inch and 6 inch Cassini Mapping)	National College of Art and Design and Oliver Bond Street	Medium	Degree or extent of soil contamination is moderate on a local scale
Tunnel	There is a pedestrian tunnel underneath James's Street connecting the Diageo St. James's Gate campus. It is likely to have a made ground backfill above it. (OSI 25 Inch Mapping)	James's Street	Medium	Degree or extent of soil contamination is moderate on a local scale
Tramway and tram depot	Tramway (OSI 25 Inch Mapping)	River Camac on Emmet Road to the end of the Proposed Scheme.	Medium	Degree or extent of soil contamination is moderate on a local scale
Historic Landfill	Backfilled quarry with landfill waste (GSI External Boreholes and Site Investigations)	North of Ballyfermot Road just as it meets Sarsfield Road	Medium	Degree or extent of soil contamination is moderate on a local scale
Inchicore Railway Works	Railway Works (OSI 25 Inch Mapping)	Sarsfield and Inchicore Road	Medium	Degree or extent of soil contamination is moderate on a local scale
Petrol Stations	Several petrol stations are located along this route.	East of Cherry Orchard Hospital on Ballyfermot Road, opposite Longmeadows Pitch and Putt Course on Sarsfield Road, and opposite St James' Hospital on Mount Brown. The site opposite 61 Ballyfermot Road (currently the location of a coffee shop) is noted as a former petrol station.	Medium	Degree or extent of soil contamination is moderate on a local scale
Asbestos Trunk Watermain	9" to 12" Asbestos Cement Trunk Watermains that will be diverted as part of the Proposed Scheme	Ballyfermot Rd opposite Cherry Orchard Hospital extending as far as St. Matthews Church, Ballyfermot Rd at the Le Fanu Rd intersection and Sarsfield Rd between First Avenue and St Mary's Avenue West.	Medium	Degree or extent of soil contamination is moderate on a local scale

A summary of the EPA licensed facilities within the study area along with their importance as determined by the NRA Guidelines Box 4.1 (NRA 2008a) is presented in Table 14.23.

Table 14.23: List of EPA Licensed Facilities Within the Study Area

Name	Description	Importance	Justification for Importance Rating
Diageo Ireland (St. James Gate)	IEL – Licensed: St. James's Gate, Dublin 8, Dublin	Medium	Light industrial usage
Diageo Ireland (St. James Gate)	IPPC – Licensed: St. James's Gate, Dublin 8, Dublin	Medium	Light industrial usage

14.3.3.10 Mineral / Aggregate Resources

Considering the location of the Proposed Scheme in the urban environment, there are unlikely to be many opportunities to extract mineral or aggregate resources, however in keeping the IGI (2013) guidelines the following datasets were consulted in order to assess the impact of the Proposed Scheme on the economic geology of the study area:

- GSI: aggregate potential mapping (GSI 2016b, GSI 2016c);
- GSI: mineral localities (GSI 2014); and
- GSI active quarries (GSI 2019d).

No active pits, mines or quarries were identified within the study area. There is one non-metallic mineral locality within the study area located at an infilled quarry (Quarryvale) to the west of Liffey Valley.

The crushed rock aggregate potential is predominately moderate potential within the study area. The granular aggregate potential is highly variable as discussed below. A summary of the aggregate resources identified in the study area (refer to Figure 14.11 and Figure 14.12 in Volume 3 of this EIAR) are outlined in Table 14.24 along with their importance as determined by the Box 4.1 of the NRA Guidelines (NRA 2008a).

14.3.3.10.1 Liffey Valley to Le Fanu Road

The GSI aggregate potential mapping shows the crushed rock aggregate potential along this section of the study area ranges from moderate to very high. High to very high is confined to the west and south west of Liffey Valley.

There are no areas of granular aggregate potential in this section of the study area.

14.3.3.10.2 Le Fanu Road to Sarsfield Road

The GSI aggregate potential mapping shows the crushed rock aggregate potential along this section of the study area is moderate with the exception of the shallow bedrock at Markievicz Park with is of high to very high crushed rock aggregate potential.

The gravels at Colepark Drive has a very high granular aggregate potential.

14.3.3.10.3 Sarsfield Road to City Centre

The GSI aggregate potential mapping shows the crushed rock aggregate potential is generally low to the north of the Proposed Scheme and moderate to the south of the Proposed Scheme within the study area for this section.

The War Memorial Garden has very high granular aggregate potential. The gravels in Inchicore have a low to high granular aggregate potential and the alluvium associated with the River Camac has a very low granular aggregate potential. The gravels to the south of Thomas Street have a medium to high potential and the alluvium associated with the River Liffey has a low to high granular aggregate potential.

Table 14.24: GSI Aggregate Potential for the Study Area

GSI Aggregate Potential Type	Potential	Location	Importance	Justification for Importance Rating
Crushed rock aggregate potential	Low potential	North of the Proposed Scheme	Low	Uneconomically extractable mineral resource
Crushed rock aggregate potential	Moderate potential	South of the Proposed Scheme	Medium	Sub-economic extractable mineral resource
Crushed rock aggregate potential	High potential	West and south west of Liffey Valley, Markievicz Park	Medium	Extractable mineral resource
Crushed rock aggregate potential	Very High potential	West and south west of Liffey Valley, Markievicz Park	High	Marginally extractable mineral resource
Granular aggregate potential	Very Low potential	River Camac, River Liffey	Low	Uneconomically extractable mineral resource
Granular aggregate potential	Low potential	Inchicore	Low	Uneconomically extractable mineral resource
Granular aggregate potential	Moderate potential	Inchicore, Thomas Street	Medium	Sub-economic extractable mineral resource
Granular aggregate potential	High potential	Inchicore, Thomas Street	Medium	Extractable mineral resource
Granular aggregate potential	Very High potential	Colepark Drive, War Memorial Garden	High	Marginally extractable mineral resource

14.3.3.11 Geological Heritage Areas

The Geological Heritage Areas (GSI 2019c) within the study area are presented on Figure 14.12 in Volume 3 of this EIAR and detailed in Table 14.25 along with their importance as determined by the NRA Guidelines Box 4.1 (NRA 2008a).

Table 14.25: Geological Heritage Areas

Name (Code)	Description	Importance	Justification for Importance Rating
Guinness Wells (DC005)	This site comprises two borehole wells dug within the Guinness brewery complex. Recommended for Geological NHA	High	Geological feature of high value on a local scale (County Geological Site)
Dublin City Walls (DC002)	Three remaining sections of the medieval city walls of Dublin City	High	Geological feature of high value on a local scale (County Geological Site)
River Poddle (DC011)	A river which flows northwards through Dublin City; most of its course is diverted underground	High	Geological feature of high value on a local scale (County Geological Site)

14.3.3.12 Aquifer Type and Classification

The GSI Bedrock Aquifer mapping (GSI 2019b) for the study area (Figure 14.13 in Volume 3 of this EIAR) indicates that there is one aquifer type within the study area as summarised in Table 14.26 along with their importance as determined by Box 4.3 of the NRA Guidelines (NRA 2008a).

The GSI Gravel Aquifer mapping (GSI 2019b) show there are no gravel aquifers within the study area.

Table 14.26: Aquifer Types Within the Study Area

Aquifer Type	Description	Location	Importance	Justification for Importance Rating
Locally Important Aquifer (Li)	Bedrock which is moderately productive only in local zones	Widespread	Medium	Locally important aquifer which supplies the local area

14.3.3.13 Groundwater Vulnerability

Groundwater vulnerability (GSI 2019b) within the study area ranges from 'extreme' vulnerability where bedrock is close to or at the surface, to 'low' vulnerability in areas where thick subsoil deposit is present as shown on Figure 14.14 in Volume 3 of this EIAR.

14.3.3.13.1 Liffey Valley to Le Fanu Road

The GSI groundwater vulnerability mapping shows the groundwater vulnerability along this section of the study area ranges from moderate to extreme. The vulnerability from Liffey Valley Shopping Centre to just past the M50 is high to extreme. The vulnerability of the underlying aquifer is moderate for the remainder of this section of the study area.

14.3.3.13.2 Le Fanu Road to Sarsfield Road

The GSI groundwater vulnerability mapping shows the groundwater vulnerability along this section of the study area ranges from moderate to extreme. The vulnerability is predominantly moderate except for where there are gravels present at Colepark Drive and shallow rock at Markievicz Park where it ranges from 'high' to 'rock at or near surface'.

14.3.3.13.3 Sarsfield Road to City Centre

The GSI groundwater vulnerability mapping shows the groundwater vulnerability along this section of the study area ranges from low to high. The vulnerability in the vicinity of Sarsfield Road is prominently low to medium. There is an area of high vulnerability near Grattan Crescent. The vulnerability is then predominantly moderate to James's Street and then low to the end of the study area.

14.3.3.14 Groundwater Recharge

The rate of groundwater recharge corresponds to the soil type as shown in Figure 14.8 and Figure 14.15 in Volume 3 of this EIAR. The study area predominately has an annual recharge range of 51mm to 100mm with the exception of the green areas north of Sarsfield Road which have an annual recharge of 1mm to 50mm.

14.3.3.15 Hydro-Ecology

There are no groundwater dependent habitats within the study area that have the status of SPA, SAC, NHA or proposed NHA (NPWS 2020).

14.3.4 Summary of Features of Importance

The importance ranking of the features, based on Box 4.1 of the NRA Guidelines (NRA 2008a), established for the baseline conditions is summarised below.

Features with an importance ranking of low are not considered further as they could not result in a significant impact according to Box 5.4 of the NRA Guidelines (NRA 2008a), however these are summarised in Table 14.27 for completeness. Features with an importance ranking of medium or higher are summarised in Table 14.28 and the impact of the Proposed Scheme on these features is assessed in Section 14.4.

Table 14.27: Summary of Land, Soils, Geology and Hydrogeology Features with Low Importance Within the Study Area

Category	Feature	Description	Location	Importance	Justification
Soil Fertility	Made Ground - Made	Associated with urban development	Widespread	Low	Poorly drained and / or low fertility soils
Soil Fertility	Topsoil - BminPD	Poorly drained (mainly basic)	Widespread in green areas	Low	Poorly drained and / or low fertility soils
Subsoils quality and significance	Made Ground - Urban	Associated with urban development	Widespread	Low	Low value on a local scale
Subsoils quality and significance	Alluvium - A	Typically found along current and historic watercourses	River Camac	Low	Low value on a local scale
Subsoils quality and significance	Glacial gravels - GLs	Gravels derived from limestones	Colepark Drive	Low	Low value on a local scale
Subsoils quality and significance	Glacial till - TLs	Till derived from limestones	Widespread	Low	Low value on a local scale
Subsoils quality and significance	Rock - Rck	Bedrock outcrop or subcrop	Markievicz Park	Low	Low value on a local scale
Bedrock quality and significance	Lucan	(Calp) Dark limestone and shale - Carboniferous	Widespread	Low	Low value on a local scale
Soft Soils	Alluvium - AlluvMIN (soils) / A (subsoils)	Typically found along current and historic watercourses	River Camac	Low	Volume of soft soil underlying the route is small and of a local scale.
Economic Geology	Crushed rock aggregate potential	Low potential	North of the Proposed Scheme	Low	Uneconomically extractable mineral resource
Economic Geology	Granular aggregate potential	Very Low potential	River Camac, River Liffey	Low	Uneconomically extractable mineral resource
Economic Geology	Granular aggregate potential	Low potential	Inchicore	Low	Uneconomically extractable mineral resource

Table 14.28: Summary of Land, Soils, Geology and Hydrogeology Features with Medium to High Importance Within the Study Area

Category	Feature	Description	Location	Importance	Justification
Soil Fertility	Alluvium - AlluvMIN	Typically found along current and historic watercourses	River Camac	Medium	Moderately drained and/or moderate fertility soils
Soil Fertility	Topsoil - BminSW	Shallow well drained (mainly basic)	Colepark Drive, Markievicz Park.	High	Well drained and / or high fertility soils
Soil Fertility	Topsoil - BminDW	Deep well drained (mainly basic)	Widespread in green areas	High	Well drained and / or high fertility soils
Licenced Facility	Diageo Ireland (St. James Gate)	IEL – Licensed: St. James's Gate, Dublin 8, Dublin	St. James's Gate, Dublin 8, Dublin	Medium	Light industrial usage
Licenced Facility	Diageo Ireland (St. James Gate)	IPPC – Licensed: St. James's Gate, Dublin 8, Dublin	St. James's Gate, Dublin 8, Dublin	Medium	Light industrial usage
Potential Sources of Contamination	Quarry	Disused gravel pit (OSI 25 Inch Mapping)	Markievicz Park.	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential Sources of Contamination	Tunnel	There is a pedestrian tunnel underneath James's Street connecting the Diageo St. James's Gate campus. It is likely to have a made ground backfill above it. (OSI 25 Inch Mapping)	James's Street	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential Sources of Contamination	Tramway and tram depot	Tramway (OSI 25 Inch Mapping)	River Camac on Emmet Road to the end of the Proposed Scheme.	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential Sources of Contamination	Historic Landfill	Backfilled quarry with landfill waste (GSI External Boreholes and Site Investigations)	North of Ballyfermot Road just as it meets Sarsfield Road	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential Sources of Contamination	Inchicore Railway Works	Railway Works (OSI 25 Inch Mapping)	Sarsfield and Inchicore Road	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential Sources of Contamination	Flour Mill	Flour Mill (OSI 6 inch mapping)	Old Kilmainham Road and Mount Brown	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential Sources of Contamination	Graveyard	Graveyard (OSI 6 inch, 25 Inch and 6 inch Cassini mapping)	Junction of Bow Lane West and James' Street and the west end of Thomas Street.	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential Sources of Contamination	Lime Kiln	Lime Kiln (OSI 25 Inch Mapping)	South of Emmet Road and Luby Road Junction.	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential Sources of Contamination	Distillery	Distillery (OSI 25 Inch and 6 inch Cassini Mapping)	National College of Art and Design and Oliver Bond Street	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential Sources of Contamination	Petrol Stations	Several petrol stations are located along this route.	East of Cherry Orchard Hospital on Ballyfermot Road, opposite Longmeadows Pitch and Putt Course on Sarsfield Road, and opposite St James' Hospital on Mount Brown. The site opposite 61 Ballyfermot Road (currently the location of a coffee shop) is noted as a former petrol station.	Medium	Degree or extent of soil contamination is moderate on a local scale

Category	Feature	Description	Location	Importance	Justification
Potential Sources of Contamination	Asbestos Trunk Watermain	9”-12” Asbestos Cement Trunk Watermains that will be diverted as part of the Proposed Scheme	Ballyfermot Rd opposite Cherry Orchard Hospital extending as far as St. Matthews Church, Ballyfermot Rd at the Le Fanu Rd intersection and Sarsfield Rd between First Avenue and St Mary's Avenue West.	Medium	Degree or extent of soil contamination is moderate on a local scale
Economic Geology	Crushed rock aggregate potential	Moderate potential	South of the Proposed Scheme	Medium	Sub-economic extractable mineral resource
Economic Geology	Crushed rock aggregate potential	High potential	West and south west of Liffey Valley, Markievicz Park	Medium	Extractable mineral resource
Economic Geology	Crushed rock aggregate potential	Very High potential	West and south west of Liffey Valley, Markievicz Park	High	Marginally extractable mineral resource
Economic Geology	Granular aggregate potential	Moderate potential	Inchicore, Thomas Street	Medium	Sub-economic extractable mineral resource
Economic Geology	Granular aggregate potential	High potential	Inchicore, Thomas Street	Medium	Extractable mineral resource
Economic Geology	Granular aggregate potential	Very High potential	Colepark Drive, War Memorial Garden	High	Marginally extractable mineral resource
County geological site	Guinness Wells (DC005)	This site comprises two borehole wells dug within the Guinness brewery complex	St James’ Gate, Dublin 8.	High	Geological feature of high value on a local scale (County Geological Site)
County geological site	Dublin City Walls (DC002)	Three remaining sections of the medieval city walls of Dublin City	Cook Street and Power’s Square (south of High Street), Dublin 8.	High	Geological feature of high value on a local scale (County Geological Site)
County geological site	River Poddle (DC011)	A river which flows northwards through Dublin city; most of its course is diverted underground	Nicholas Street, Dublin 8.	High	Geological feature of high value on a local scale (County Geological Site)
Aquifer	Locally Important Aquifer (LI)	Bedrock which is moderately productive only in local zones	Widespread	Medium	Locally important aquifer which supplies the local area

14.3.5 Conceptual Site Model

A Conceptual Site Model (CSM) was developed based on all publicly available data.

The Proposed Scheme is predominantly underlain by made ground over alluvium (at water crossings) over glacial till over limestone bedrock. The relevant subsections of the Proposed Scheme are presented in Table 14.30 to Table 14.31 along with the fill height (average and maximum), cut height (average and maximum), and the soils and geology at each earthwork area.

Table 14.29: Conceptual Site Model – Liffey Valley to Le Fanu Road

Subsection	Length (m)	Dominant Earthworks Type	Cut (m)		Fill (m)		Ground Conditions	Average Thickness of Made Ground (m)	Additional Notes
			Max	Avg	Max	Avg			
Fonthill Road to Coldcut Road (Ch A500 to B750)	1,300	At Grade	0	0	1	0	Based on desk study information made ground over glacial till.	0.5	Localised pavement reconstruction / widening works and junction modification works. 100m long, 1m high proposed pre-cast reinforced concrete (RC) cantilever wall on north side of Coldcut Road.
Ballyfermot Road to Le Fanu Road (Ch B750 to B2400)	1,580	At Grade	1	0	0	0	Based on desk study information made ground over glacial till.	0.5	Localised pavement reconstruction / widening works and junction modification works.
Retaining Wall RW13 (Ch. B295 to B395)	100	Structure	No Cut / Fill due to existence of structure				Based on desk study information made ground over glacial till.	0.5	Proposed pre-cast RC cantilever wall on north side of Coldcut Road. Highway to be widened behind proposed wall. Max retained height is 1.0m.

Table 14.30: Conceptual Site Model – Le Fanu Road to Sarsfield Road

Subsection	Length (m)	Dominant Earthworks Type	Cut (m)		Fill (m)		Ground Conditions	Average Thickness of Made Ground (m)	Additional Notes
			Max	Avg	Max	Avg			
Ballyfermot Road (Le Fanu Road) to Sarsfield Road (Ch B2400 to B4700)	2,605	At Grade	3	0	0	0	Based on desk study information made ground over glacial till.	0.5	Localised pavement reconstruction / widening works and junction modification works. Four proposed pre-cast RC cantilever retaining walls proposed along this section as outlined below.
Retaining Wall RW08 (Ch. B3495 to B3555)	60	Structure	No Cut / Fill due to existence of structure				Based on desk study information made ground over glacial till.	0.5	Proposed pre-cast RC cantilever wall on south side of R833 Ballyfermot Road. Existing embankment to be excavated up to wall. Max retained height is 1.0m.
Retaining Wall RW09 (Ch. B3800 to B3820)	20	Structure	No Cut / Fill due to existence of structure				Based on desk study information made ground over glacial till.	0.5	Proposed pre-cast RC cantilever wall on north side of R833 Sarsfield Road. Existing wall to be demolished and ground set back. Max retained height is 1.0m.
Retaining Wall RW10 (Ch. B3840 to B3910)	80	Structure	No Cut / Fill due to existence of structure				Based on desk study information made ground over glacial till.	0.5	Proposed pre-cast RC cantilever wall on north side of R833 Sarsfield Road. Existing wall to be demolished and ground excavated to accommodate proposed attenuation pond. Max retained height is 3.0m.
Retaining Wall RW11 (Ch. B3920 to B4180)	260	Structure	No Cut / Fill due to existence of structure				Based on desk study information made ground over glacial till.	0.5	Proposed pre-cast RC cantilever wall on north side of R833 Sarsfield Road. Existing wall to be demolished and ground excavated up to wall. Max retained height is 2.5m.

Table 14.31: Conceptual Site Model - Sarsfield Road to City Centre

Subsection	Length (m)	Dominant Earthworks Type	Cut (m)		Fill (m)		Ground Conditions	Average Thickness of Made Ground (m)	Additional Notes
			Max	Avg	Max	Avg			
Sarsfield Road to South Circular Road (Ch. B4460 to B6580)	1,905	At Grade	0	0	0	0	Based on desk study information made ground over glacial till.	0.5	Localised pavement reconstruction / widening works and junction modification works.
South Circular Road to Bow Lane West (Ch. B6580 to B7705)	1,120	At Grade	0	0	0	0	Based on desk study information made ground over glacial till.	0.5	Localised pavement reconstruction and junction modification works.
Bow Lane West to High Street (Ch. B7705 to B9020)	1,220	At Grade	0	0	0	0	Based on desk study information made ground over glacial till.	0.5	Localised pavement reconstruction and junction modification works.

14.3.5.1 Environment Type

The environment across the study area has been categorised in accordance with the IGI Guidelines. It has been classified as:

- Type A environment which corresponds to a passive geological / hydrogeological environment – examples include areas of thick low permeability subsoils, areas underlain by poor aquifers, recharge areas, historically stable geological environments.

14.4 Potential Impacts

This Section presents potential impacts that may occur due to the Proposed Scheme, in the absence of mitigation. This informs the need for mitigation or monitoring to be proposed (refer to Section 14.5). Predicted 'residual' impacts taking into account any proposed mitigation is presented in Section 14.6.

14.4.1 Characteristics of the Proposed Scheme

A detailed description of the Proposed Scheme and construction activities are provided in Chapter 4 (Proposed Scheme Description) and Chapter 5 (Construction).

This section outlines the key design features, characteristics and construction activities of the Proposed Scheme of relevance to land, soils, geology and hydrogeology.

A Construction Environmental Management Plan (CEMP) is provided in Appendix A5.1 in Volume 4 of this EIAR.

14.4.1.1 Liffey Valley to Le Fanu Road

- Carriageway widening will be the main construction activity throughout this section of the Proposed Scheme. Full depth pavement construction will be required, to facilitate widening of the carriageway into existing footways and green areas.
- A raised cycle track will be constructed throughout in both directions;
- Two roundabouts on the Fonthill Road will be converted to signalised junctions. The Coldcut Road junction will receive a major reconfiguration, to provide bus priority and improved cycling and walking facilities;
- Signal Controlled Priority will be provided at the M50 Overbridge. Either side of the M50 Overbridge will also be widened;
- Localised reconstruction of boundary walls will be completed between the M50 overbridge and to Cloiginn Park;
- Parallel access roads will be removed to facilitate carriageway widening, cycle tracks and footway improvements between Cherry Orchard Service Station and Le Fanu Road;
- The Cloverhill Road junction will be reconfigured;
- Some minor utility diversions and / or protections will be required. A 9" to 12" asbestos cement trunk watermain will be diverted as part of the Proposed Scheme into the verge / footway on the Ballyfermot Road opposite Cherry Orchard Hospital extending as far as St. Matthews Church and a 9" asbestos cement trunk watermain will be diverted into the verge / footway on the Ballyfermot Road at the Le Fanu Road intersection;
- Construction Compound 1 (LV1) will be located along the Fonthill Road, 5m south of the Tesco car park; and
- Construction Compound 2 (LV2) will be located at lands adjacent to the Eir exchange building on the Coldcut Road, between Cloverhill Road and Ballyfermot Road.

14.4.1.2 Le Fanu Road to Sarsfield Road

- The Ballyfermot Road / Kylemore Road Roundabout will be converted to a signalised junction and Kylemore Road will be upgraded to include cycle tracks and formalised parking;

- The carriageway will be widened at numerous locations through this section of the Proposed Scheme. Full depth pavement construction will be required to facilitate carriageway widening, into existing footways and green areas;
- Localised reconstruction of boundary walls will be required between Kylemore Road to St Laurence's Road and again from St Laurence's Road to Sarsfield Road Junction. The carriageway will be narrowed to facilitate cycle track and footway improvements. The lanes will be reconfigured throughout this section;
- A retaining wall 330m in length, 3m high will be constructed at Longmeadows Pitch and Putt Park;
- Sarsfield Road junction will be reconfigured; and
- Some minor utility diversions and / or protections will be required. A 9" asbestos cement trunk watermain will be diverted as part of the Proposed Scheme into verge / footway on Sarsfield Road between First Avenue and St Mary's Avenue West.

14.4.1.3 Sarsfield Road to City Centre

- Minor changes to the existing carriageway are expected. Road space will be reallocated along Grattan Crescent, to accommodate bus lanes in each direction;
- The carriageway will be widened at some areas, along Emmet Road to South Circular Road Junction;
- Full depth construction will be required to facilitate carriageway widening, into existing footways. The carriageway along James's Street, Thomas Street And High Street will be narrowed to facilitate cycle tracks. The lanes will be reconfigured throughout this section;
- The Memorial Road, Inchicore Road junction will be reconfigured. Memorial Road will be converted from one-way traffic to two-way traffic;
- Construction Compound 3 (LV3) will be located north of Con Colbert Road near the Liffey Gaels GAA grounds and will be the main works compound during construction. The construction compound is adjacent to the tie in for the proposed Lucan to City Centre Core Bus Corridor Scheme; and
- Some minor utility diversions and / or protections will be required.

14.4.1.4 Operational Phase

The impact assessment for the Operational Phase has been undertaken in terms of impact analysis of the Proposed Scheme on the local environment from a land, soils, geology and hydrogeology perspective. This is set out in the following sections.

14.4.2 'Do Nothing' Scenario

In the Do Nothing scenario the Proposed Scheme would not be implemented and there would be no resulting impacts on the land, soils, geology and hydrogeology along the route of the Proposed Scheme. The impact would therefore be neutral.

14.4.3 Construction Phase

The potential land, soils, geology and hydrogeology impacts during the Construction Phase for the relevant construction activities described in Section 14.4.1 are presented in this Section, along with their impact significance. These potential impacts also relate and interact with other environmental factors which are described within the EIAR. Specific interactions are outlined in Section 14.1.

The Proposed Scheme will have the following potential impacts on the land, soils, geology and hydrogeology as discussed below and summarised in Table 14.32:

- Loss or damage of topsoil;
- Excavation of potentially contaminated ground;
- Loss of future quarry or pit reserve;
- Loss or damage of proportion of Geological Heritage Area;

- Loss or damage of proportion of aquifer; and
- Change to groundwater regime.

Though the magnitude of the impact may vary depending on the scale of activities and location of the Proposed Scheme relative to the impacted important feature, in order to ensure a robust assessment, only the maximum magnitude or "worst case" of the impact of the Proposed Scheme is discussed.

14.4.3.1 Loss or Damage of Topsoil

Topsoil is a non-renewable resource which if removed or damaged can result in a permanent irreversible negative impact. The potential ways in which this can occur as a result of the Proposed Scheme are as follows:

- There is the potential for materials on site to be spilled resulting in the pollution of the topsoil. For example, raw or uncured concrete and grouts, washed down water from exposed aggregate surfaces, cast-in-place concrete from concrete trucks, fuels, lubricants and hydraulic fluids for equipment used on the development site, bitumen and sealants used for waterproofing concrete surfaces can all potentially impact on soils and groundwater during the Construction Phase;
- These excavated soil materials will be stockpiled using appropriate methods to minimise the impacts of weathering. Materials that are stockpiled incorrectly can be exposed to erosion and weathering which reduces the quality of the resource;
- Excavations in areas of contaminated ground during the construction works may mobilise pollution contained in the soils into the nearby topsoil;
- Permanent damage of topsoil through waterlogging, sealing, washout of fines and erosion. This would be due to the trafficking of plant, regrading of slopes, laying of hardstanding surfaces and storage of materials in areas not intended to be paved as part of the Proposed Scheme; and
- Excavation and disposal of topsoil instead of its reuse or reinstatement.

Topsoil will be encountered in numerous areas across the Proposed Scheme as discussed in Section 14.3.3.3. where topsoil is stripped to accommodate the works outlined above, all of the above impacts could potentially occur at these locations. Topsoil will be encountered when establishing Construction Compound LV1 which will be located in a green area adjacent to the Tesco Extra, Fonthill Road and Construction Compound LV3 which will be located within Liffey Gaels Park.

The magnitude of these impacts on the topsoil is small adverse, as it results in a permanent irreversible loss of a small proportion of locally high fertility topsoil and/or a high proportion of locally low fertility topsoils within the study area. As the topsoil is of high importance the resulting significance of this permanent small adverse potential impact is slight.

The magnitude of impact of the Proposed Scheme on the alluvium is negligible. As these soils are of medium importance the resulting significance of this negligible potential impact is imperceptible.

14.4.3.2 Excavation of Potentially Contaminated Ground

The excavation of made ground results in the production of excess material that requires placement elsewhere in the scheme or removal off-site and / or the mobilisation of possible contaminants. The majority of the Proposed Scheme will encounter made ground as discussed in Section 14.3.3.1 and Section 14.3.3.3

Exposure of locations of contamination and excavation of contaminated soil may potentially lead to a risk to the surrounding environment or underlying soil if not dealt with in an appropriate manner in accordance with the Environmental Protection Agency guidance on Land Contamination (EPA 2013). The underlying soil could be impacted from the exposure of previous buried hazardous material, in an unlicensed dumping site for example.

Potential sources of contamination relevant to the Proposed Scheme identified within the study area are detailed in Table 14.22 and include stockpiles of made ground, petrol stations and the historic backfilled quarries near Markievicz Park.

The magnitude of this impact is small adverse as it results in the excavation of a small proportion of contaminated land. As the potential contaminated ground is of medium importance the resulting significance of the permanent small adverse potential impact is slight.

14.4.3.3 Loss of Future Quarry or Pit Reserve

The excavation of soil and rock during construction can diminish future quarry and pit reserves. This can result in a permanent irreversible loss of the in-situ characteristics of the land, soils and geology area. However, there are no notable existing or historic quarries with the study area of the Proposed Scheme.

The magnitude of this impact is negligible as it results in an insufficient permanent irreversible change on a local scale to affect the integrity of the land and soils as a potential future quarry or pit reserve above the Do Nothing scenario.

As the aggregate potential is of medium to high importance the resulting significance of this negligible potential impact is imperceptible and will not be considered further.

14.4.3.4 Loss or Damage of Proportion of Geological Heritage Area

The sealing, contamination or excavation of soil and rock during construction can diminish the value of geological heritage areas. This can result in a permanent irreversible loss of the in-situ characteristics of the land, soils, geology and hydrogeology of the area.

The magnitude of this impact is negligible on the Guinness Wells, Dublin City Walls and River Poddle County Geological Sites as while they are within study area there will be no direct interaction during construction and as such, results in an insufficient permanent irreversible change on a local scale to affect the integrity of the county geological site.

As the Guinness Wells, Dublin City Walls and River Poddle county geological sites are of high importance the resulting significance of this negligible potential impact is imperceptible and therefore will not be will not be considered further.

14.4.3.5 Loss or Damage of Proportion of Aquifer

The removal of a proportion of an aquifer can reduce its ability to provide baseflow to groundwater dependant habitats and / or water supplies and results in an irreversible loss of the in-situ characteristics of the land, soils, geology and hydrogeology. Likewise, the mobilisation of contaminants into the aquifer either through accidental spillage or disturbance of contaminated ground during excavation will reduce the quality of the groundwater within the aquifer.

The underlying limestone bedrock is defined as a locally important aquifer and though close to surface in areas, there will be minimal excavation into the limestone rock as part of the Proposed Scheme. The magnitude of this impact is negligible as it results in no measurable change which may affect the integrity of the underlying aquifer. As the aquifer is a locally important aquifer of medium importance the resulting significance of this negligible potential impact is imperceptible and will not be considered further.

In addition to the above impact, potential pollutants from routine run-off during construction or mobilisation of pollution from the disturbance of contaminated ground during construction activities (particularly excavations) have the potential to alter the groundwater quality temporarily in the study area. The magnitude of this impact is moderate adverse as it results in a temporary potential medium risk of pollution to groundwater. As the aquifer is a locally important aquifer of medium importance the resulting significance of this temporary moderate adverse potential impact is moderate.

14.4.3.6 Change to Groundwater Regime

Localised pumping of excavations may be required as part of the Construction Phase in order to allow works to be carried out in dry excavations. This could lead to a temporary change in the groundwater levels and flow within the locally important aquifer underlying the Proposed Scheme.

Since the pumping is expected to be limited, localised and temporary, the magnitude of this impact is considered negligible. As the importance of the locally important aquifer is medium, the resulting significance is imperceptible and therefore will not be considered further.

Table 14.32: Summary of Potential Construction Phase Impacts

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Magnitude	Significance
Loss or Damage of Topsoil									
Soil Fertility	Alluvium - AlluvMIN	River Camac	Medium	Loss or damage of topsoil	Negative	Permanent	Local	Negligible	Imperceptible
Soil Fertility	Topsoil - BminSW	Colepark Drive, Markievicz Park.	High	Loss or damage of fertile soil	Negative	Permanent	Local	Small adverse	Slight
Soil Fertility	Topsoil - BminDW	Widespread in green areas	High	Loss or damage of fertile soil	Negative	Permanent	Local	Small adverse	Slight
Excavation of Potentially Contaminated Ground									
Licensed Facility	Diageo Ireland (St. James Gate)	St. James's Gate, Dublin 8, Dublin	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Quarry	Markievicz Park.	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Flour Mill	Old Kilmainham Road and Mount Brown,	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Graveyard	Junction of Bow Lane West and James's Street and the west end of Thomas Street.	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Lime Kiln	South of Emmet Road and Luby Road Junction. South of Emmet Road and Luby Road Junction.	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Distillery	National College of Art and Design and Oliver Bond Street	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Petrol Stations	East of Cherry Orchard Hospital on Ballyfermot Road, opposite Longmeadows Pitch and Putt Course on Sarsfield Road, and opposite St James' Hospital on Mount Brown. The site opposite 61 Ballyfermot Road (currently the location of a coffee shop) is noted as a former petrol station.	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Asbestos Trunk Watermain	Ballyfermot Road opposite Cherry Orchard Hospital extending as far as St. Matthew's Church, Ballyfermot Road at the Le Fanu Road intersection and Sarsfield Road between First Avenue and St Mary's Avenue West.	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Tunnel	James's Street	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Magnitude	Significance
Potential Sources of Contamination	Tramway and tram depot	River Camac on Emmet Road to the end of the Proposed Scheme.	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Historic Landfill	North of Ballyfermot Road just as it meets Sarsfield Road	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Inchicore Railway Works	Sarsfield and Inchicore Road	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Loss of Future Quarry Reserve									
Economic Geology	Crushed rock aggregate potential – moderate	South of the Proposed Scheme	Medium	Loss of future quarry reserve	Negative	Permanent	Local	Negligible	Imperceptible
Economic Geology	Crushed rock aggregate potential – high	West and south west of Liffey Valley, Markievicz Park	Medium	Loss of future quarry reserve	Negative	Permanent	Local	Negligible	Imperceptible
Economic Geology	Crushed rock aggregate potential – very high	West and south west of Liffey Valley, Markievicz Park	High	Loss of future quarry reserve	Negative	Permanent	Local	Negligible	Imperceptible
Economic Geology	Granular aggregate potential – moderate	Inchicore, Thomas Street	Medium	Loss of future quarry reserve	Negative	Permanent	Local	Negligible	Imperceptible
Economic Geology	Granular aggregate potential – high	Inchicore, Thomas Street	Medium	Loss of future quarry reserve	Negative	Permanent	Local	Negligible	Imperceptible
Economic Geology	Granular aggregate potential – very high	Colepark Drive, War Memorial Garden	High	Loss of future quarry reserve	Negative	Permanent	Local	Negligible	Imperceptible
Loss or Damage of Proportion of Geological Heritage Area									
Guinness Wells (DC005)	Guinness Wells (DC005)	St James' Gate, Dublin 8	High	Loss or damage of proportion of Geological Heritage Area	Negative	Permanent	Local	Negligible	Imperceptible
Dublin City Walls (DC002 County Geological Site)	Three remaining sections of the medieval city walls of Dublin city	Cook Street and Power's Square (south of High Street), Dublin 8	High	Loss or damage of proportion of Geological Heritage Area	Negative	Permanent	Local	Negligible	Imperceptible
River Poddle (DC011 County Geological Site)	A river which flows northwards through Dublin city; most of its course is diverted underground	Nicholas Street, Dublin 8	High	Loss or damage of proportion of Geological Heritage Area	Negative	Permanent	Local	Negligible	Imperceptible
Loss or Damage of Proportion of Aquifer Through Pollution									
Aquifer	Locally Important Aquifer (LI)	Widespread	Medium	Loss or damage of proportion of aquifer through excavation	Negative	Permanent	Local	Negligible	Imperceptible
Aquifer	Locally Important Aquifer (LI)	Widespread	Medium	Loss or damage of proportion of aquifer through pollution	Negative	Temporary	Local	Moderate Adverse	Moderate
Change to Groundwater Regime									
Aquifer	Locally Important Aquifer (LI)	Widespread	Medium	Change to groundwater regime	Negative	Temporary	Local	Negligible	Imperceptible

14.4.4 Operational Phase

14.4.4.1 Contamination

The Operational Phase has the potential to lead to occasional accidental leakage of oil, petrol or diesel, allowing contamination of the surrounding environment. There will still be the potential for accidental spillages as with the Do Nothing scenario, therefore the magnitude of the impact is negligible.

Therefore, the significance of the potential impact is Imperceptible on any assessed aspects of land, soils, geology and hydrogeology.

14.5 Mitigation and Monitoring Measures

The following Sections outline the mitigation and monitoring measures associated with the potential impacts identified in Section 14.4 for both the Construction and the Operational Phases of the Proposed Scheme. A summary of the pre-mitigation and post-mitigation impacts is contained in Table 14.33.

14.5.1 Construction Phase

14.5.1.1 Loss or Damage of Topsoil

Excavated topsoils will be stockpiled by the appointed contractor using appropriate methods to minimise the effects of weathering. Care will be taken in reworking this material to minimise dust generation, groundwater infiltration and generation of runoff.

All topsoil or subsoil shall be assessed for re-use within the Proposed Scheme by the appointed contractor ensuring the appropriate handling, processing and segregation of the material. Where practical the removal of topsoil from the Proposed Scheme will be avoided. All earthworks will be undertaken in accordance with TII Specification for Road Works (SPW) Series 600 Earthworks (TII 2013) and project-specific earthworks specifications ensuring that all excavated material and imported material is classified using the same methodology to allow maximum opportunity for the reuse of materials on site.

The impact of the production of excess material for removal off site is discussed in Chapter 18 (Waste & Resources).

14.5.1.2 Excavation of Potentially Contaminated Ground

The appointed contractor will ensure that excavations shall be kept to a minimum, using shoring or trench boxes where appropriate. For more extensive excavations, a temporary works designer shall be appointed by the appointed contractor to design excavation support measures in accordance with all relevant guidelines that minimises the excavation of contaminated ground.

The appointed contractor will be responsible for regular testing of excavated soils to monitor the suitability of the soil for reuse.

Samples of ground suspected of contamination will be tested for contamination by the appointed contractor during the detailed ground investigation and ground excavated from these areas will be disposed of to a suitably licensed or permitted site in accordance with the current Irish waste management legislation.

Any dewatering in areas of contaminated ground shall be designed by the appointed contractor to minimise the mobilisation of contaminants into the surrounding environment.

14.5.1.3 Pollution of Soil and Groundwater

Good construction management practices as outlined in the CIRIA guidance Control of Water Pollution from Construction Sites – Guidance for consultants and contractors (Masters-Williams *et al*. 2001) will be employed by the appointed contractor to minimise the risk of transmission of hazardous materials as well as pollution of

adjacent watercourses and groundwater. The construction management of the site will take account of these recommendations to minimise as far as possible the risk of soil, groundwater and surface water contamination.

Measures to be implemented to minimise the risk of spills and contamination of soils and waters include:

- Employing only competent and experienced workforce, and site-specific training of site managers, foremen and workforce, including all subcontractors, in pollution risks and preventative measures;
- Ensure that all areas where liquids (including fuel) are stored, or cleaning is carried out, are in designated impermeable areas that are isolated from the surrounding area and within a secondary containment system, e.g. by a roll-over bund, raised kerb, ramps or stepped access;
- The location of any fuel storage facilities shall be considered in the design of all construction compounds. These are to be designed in accordance with relevant guidelines and codes of best practice and will be fully bunded;
- Good housekeeping at the site (daily site clean-ups, use of disposal bins, etc.) during the entire Construction Phase;
- All concrete mixing and batching activities will be located in areas away from watercourses and drains;
- Potential pollutants to be adequately secured against vandalism;
- Provision of proper containment of potential pollutants according to codes of best practice;
- Thorough control during the entire Construction Phase to ensure that any spillage is identified at early stage and subsequently effectively contained and managed; and
- Spill kit to be provided and to be kept close to the storage area. Staff to be trained on how to use spill kits correctly.

An Environmental Incident Response Plan will be implemented by the appointed contractor, which will identify the actions to be taken in the event of a pollution incident. It will address such aspects as containment measures, emergency discharge routes, a list of appropriate equipment and clean-up materials and notification procedures to inform the relevant environmental protection authority. Refer to Appendix A5.1 CEMP in Volume 4 of this EIAR.

Sediment control methods are outlined in the Surface Water Management Plan in Appendix A5.1 CEMP in Volume 4 of this EIAR, and these will be implemented by the appointed contractor.

14.5.2 Operational Phase

With the implementation of the proposed design, no additional mitigation measures for land, soils, geology and hydrogeology are considered necessary for the operation of the Proposed Scheme.

In the Operational Phase the infrastructure will be maintained by the local authority and will be subject to their management procedures to ensure that the correct measures are taken in the event of any accidental spillages and this will reduce the potential for any impact.

14.6 Residual Impacts

No significant residual impacts have been identified either in the Construction or Operational Phases of the Proposed Scheme, whilst meeting the scheme objectives set out in Chapter 1 (Introduction).

14.6.1 Construction Phase

With the efficacious implementation of the above mitigation measures, there will be no significant residual impacts on land, soils, geology and hydrogeology as a result of the Construction Phase of the Proposed Scheme.

Table 14.33: Summary of Predicted Construction Phase Impacts Following the Implementation of Mitigation and Monitoring Measures

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Pre-mitigation Magnitude	Pre-mitigation Significance	Post-mitigation Magnitude	Post-mitigation Significance
Loss or Damage to Topsoil											
Soil Fertility	Alluvium - AlluvMIN	River Camac	Medium	Loss or damage of topsoil	Negative	Permanent	Local	Negligible	Imperceptible	Negligible	Imperceptible
Soil Fertility	Topsoil - BminSW	Colepark Drive, Markievicz Park.	High	Loss or damage of fertile soil	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Soil Fertility	Topsoil - BminDW	Widespread in green areas	High	Loss or damage of fertile soil	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Excavation of Potentially Contaminated Ground											
Licensed Facility	Diageo Ireland (St. James Gate)	St. James's Gate, Dublin 8, Dublin	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Quarry	Markievicz Park.	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Flour Mill	Old Kilmainham Road and Mount Brown	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Graveyard	Junction of Bow Lane West and James's Street and the west end of Thomas Street.	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Lime Kiln	South of Emmet Road and Luby Road Junction.	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Distillery	National College of Art and Design and Oliver Bond Street	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Pre-mitigation Magnitude	Pre-mitigation Significance	Post-mitigation Magnitude	Post-mitigation Significance
Potential Sources of Contamination	Petrol Stations	East of Cherry Orchard Hospital on Ballyfermot Road, opposite Longmeadows Pitch and Putt Course on Sarsfield Road, and opposite St James' Hospital on Mount Brown. 61 Ballyfermot road is noted as a former petrol station.	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Asbestos Trunk Watermain	Ballyfermot Road opposite Cherry Orchard Hospital extending as far as St. Matthew's Church, Ballyfermot Road at the Le Fanu Road intersection and Sarsfield Road between First Avenue and St Mary's Avenue West.	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Tunnel	James's Street	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Tramway and tram depot	River Camac on Emmet Road to the end of the Proposed Scheme.	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Historic Landfill	North of Ballyfermot Road just as it meets Sarsfield Road	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Inchicore Railway Works	Sarsfield and Inchicore Road	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Loss of future Quarry or Pit Reserve											
Economic Geology	Crushed rock aggregate potential - moderate	South of the Proposed Scheme	Medium	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible	Negligible	Imperceptible
Economic Geology	Crushed rock aggregate potential -high	West and south west of Liffey Valley, Markievicz Park	Medium	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible	Negligible	Imperceptible
Economic Geology	Crushed rock aggregate potential – very high	West and south west of Liffey Valley, Markievicz Park	High	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible	Negligible	Imperceptible

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Pre-mitigation Magnitude	Pre-mitigation Significance	Post-mitigation Magnitude	Post-mitigation Significance
Economic Geology	Granular aggregate potential - moderate	Inchicore, Thomas Street	Medium	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible	Negligible	Imperceptible
Economic Geology	Granular aggregate potential - high	Inchicore, Thomas Street	Medium	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible	Negligible	Imperceptible
Economic Geology	Granular aggregate potential – very high	Colepark Drive, War Memorial Garden	High	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible	Negligible	Imperceptible
Loss or Damage of Proportion of Geological Heritage Area											
Guinness Wells (DC005)	Guinness Wells (DC005)	St James' Gate, Dublin 8.	High	Loss or damage of proportion of Geological Heritage Area	Negative	Permanent	Local	Negligible	Imperceptible	Negligible	Imperceptible
Dublin City Walls (DC002 County Geological Site)	Three remaining sections of the medieval city walls of Dublin city	Cook Street and Power's Square (south of High Street), Dublin 8.	High	Loss or damage of proportion of Geological Heritage Area	Negative	Permanent	Local	Negligible	Imperceptible	Negligible	Imperceptible
River Poddle (DC011 County Geological Site)	A river which flows northwards through Dublin city; most of its course is diverted underground	Nicholas Street, Dublin 8.	High	Loss or damage of proportion of Geological Heritage Area	Negative	Permanent	Local	Negligible	Imperceptible	Negligible	Imperceptible
Loss or Damage of Proportion of Aquifer Through Pollution											
Aquifer	Locally Important Aquifer (LI)	Widespread	Medium	Loss or damage of proportion of aquifer through excavation	Negative	Permanent	Local	Negligible	Imperceptible	Negligible	Imperceptible
Aquifer	Locally Important Aquifer (LI)	Widespread	Medium	Loss or damage of proportion of aquifer through pollution	Negative	Temporary	Local	Moderate Adverse	Moderate	Negligible	Imperceptible
Change to Groundwater Regime											
Aquifer	Locally Important Aquifer (LI)	Widespread	Medium	Change to groundwater regime	Negative	Temporary	Local	Negligible	Imperceptible	Negligible	Imperceptible

14.6.2 Operational Phase

No significant residual impacts on land, soils, geology and hydrogeology as a result of the Operational Phase of the Proposed Scheme have been identified.

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